SCIENTIFIC AMERICAN

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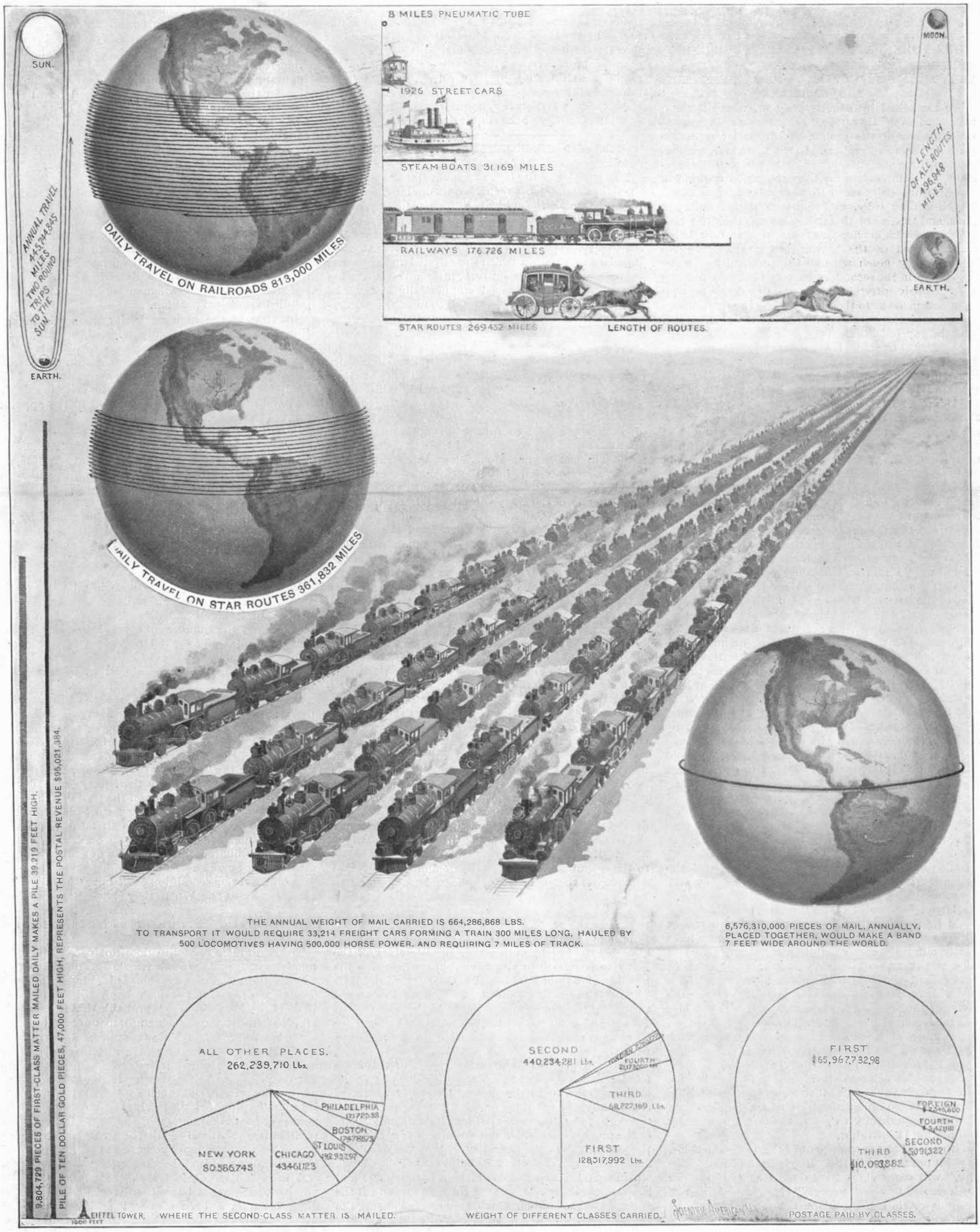
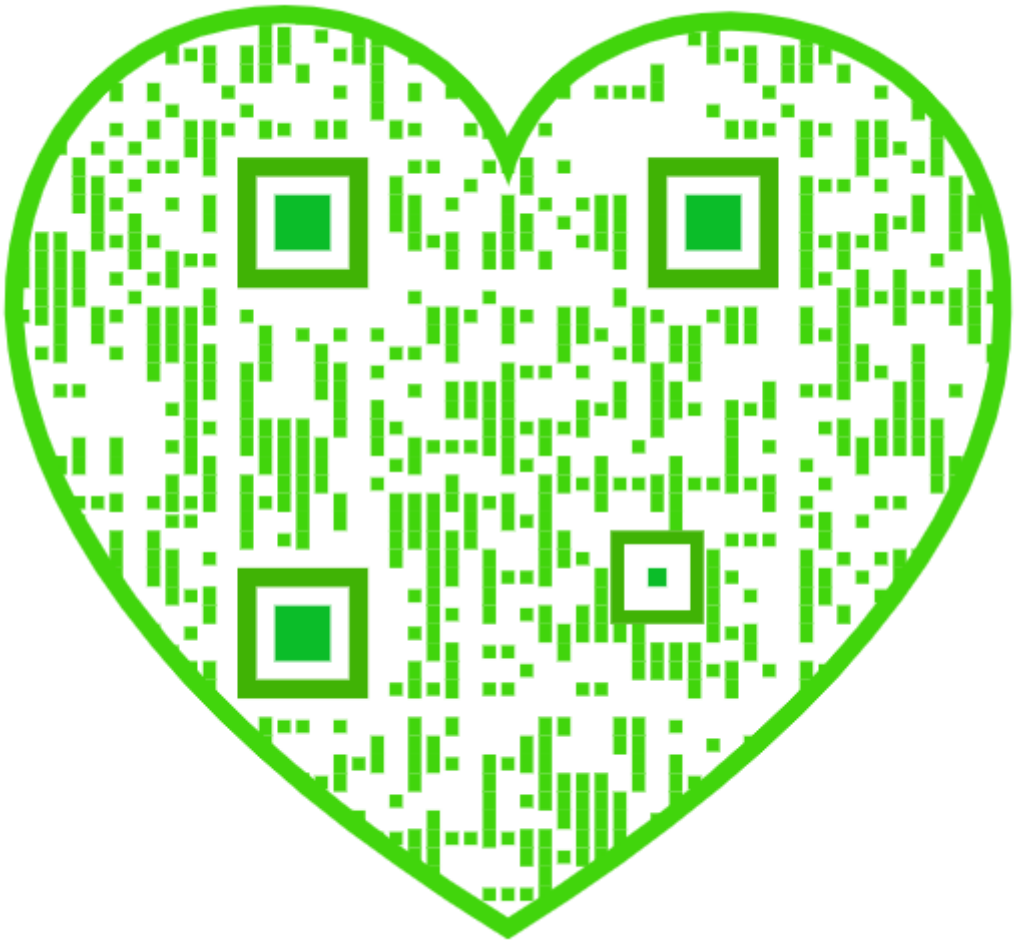

SUN.
ANNUAL TRAVEL 445,744,845 MILES TWO ROUND TRIPS TO THE SUN
EARTH.
DAILY TRAVEL ON RAILROADS 813,000 MILES
DAILY TRAVEL ON STAR ROUTES 361,832 MILES
9,804,729 PIECES OF FIRST-CLASS MATTER MAILED DAILY MAKES A PILE 39,219 FEET HIGH.
PILE OF TEN DOLLAR GOLD PIECES, 47,000 FEET HIGH, REPRESENTS THE POSTAL REVENUE $95,021,384.
8 MILES PNEUMATIC TUBE
1926 STREET CARS
STEAMBOATS 31,169 MILES
RAILWAYS 176,726 MILES
STAR ROUTES 269,452 MILES
LENGTH OF ROUTES.
MOON.
LENGTH OF ALL ROUTES 496,948 MILES
EARTH.
THE ANNUAL WEIGHT OF MAIL CARRIED IS 664,286,868 LBS.
TO TRANSPORT IT WOULD REQUIRE 33,214 FREIGHT CARS FORMING A TRAIN 300 MILES LONG, HAULED BY 500 LOCOMOTIVES HAVING 500,000 HORSE POWER, AND REQUIRING 7 MILES OF TRACK.
6,576,310,000 PIECES OF MAIL, ANNUALLY, PLACED TOGETHER, WOULD MAKE A BAND 7 FEET WIDE AROUND THE WORLD.
ALL OTHER PLACES. 262,239,710 Lbs.
NEW YORK 80,586,745
CHICAGO 43461123
ST LOUIS 19295297
BOSTON 17478853
PHILADELPHIA 17172033
EIFFEL TOWER 1000 FEET
WHERE THE SECOND-CLASS MATTER IS MAILED.
SECOND 440,234,281 Lbs.
FOURTH 21,173,000 Lbs.
THIRD 68,227,169 Lbs.
FIRST 128,517,992 Lbs.
WEIGHT OF DIFFERENT CLASSES CARRIED.
FIRST $65,967,732.98
FOREIGN $ 2,546,600
FOURTH $ 3,421,181
SECOND $ 4,509,322
THIRD $10,093,882.
POSTAGE PAID BY CLASSES.

A GRAPHICAL REPRESENTATION OF SOME INTERESTING FEATURES OF THE UNITED STATES POSTAL SERVICE.—[See page 166.]



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NEW YORK, SATURDAY, SEPTEMBER 15, 1900.

THE ARMAMENT OF OUR NEW BATTLESHIPS AND CRUISERS.

We are asked by a correspondent, whose letter is published on another page, to express an opinion as to the efficiency of the armament of our latest battleships and armored cruisers. In the first place, with regard to the armored cruisers, of 13,500 tons displacement, it is sufficient to say that the latest decision of the government is to arm these vessels with four 8-inch breech-loading rifles, and fourteen 6-inch rapid-fire guns, and that all of these weapons will be of the new long caliber, high-velocity type, which is now being manufactured at the Washington gun shops. We question very much whether the proposal to use the 5-inch gun in the secondary battery of these ships was very seriously entertained, and it is probable that an error was made as to the caliber when the figures were given out by the government. At any rate, it is certain that the day of the 5-inch rapid-fire gun in the secondary battery of our large battleships and cruisers is over. In estimating the power of the armament of our latest ships, it is necessary to bear in mind what an enormous advance has been made in the ballistics of our naval guns. If our correspondent will turn to the SCIENTIFIC AMERICAN of January 20, he will find a diagram showing the increase in length and weight of the naval 6-inch gun during the past few years. If the 6-inch gun carried by the "Baltimore" be compared with one of the new, rapid-fire, 6-inch guns of the secondary battery of our armored cruisers, it will be found that the weight has increased from 4·8 tons to 8·2 tons, while the length has increased from 30 calibers to 50; the velocity has risen from 2,000 to 2,900 foot-seconds, and the muzzle energy from 2,773 to 5,838 foot-tons, or more than a hundred per cent. The gun crew of the "Baltimore" is doing good work if it fires one shot per minute; whereas, if called upon to do so, each of the fourteen 6-inch guns on the new armored cruisers could deliver five aimed shots per minute.

The new 8-inch gun, four of which are to form the main armament of the new cruisers, because of its great velocity, will strike a blow whose muzzle energy is equal to that of the 10-inch guns of the late battleship "Maine." It will be capable of delivering at least two aimed shots per minute, capable of penetrating 13½ inches of Harveyized armor at the muzzle, and 9 inches at a distance of 2 miles; at which distance, by the way, the new 6-inch gun would be able to penetrate the 5½-inch side armor of the "Kentucky" and "Kearsarge." It is true that 4,000 tons is a big increase over a ship like the "Brooklyn," but it must be remembered that these ships will have a guaranteed speed of 22 knots an hour, and that they will carry an enormous coal supply, besides being completely covered with side armor at the water-line from stem to stern.

Undoubtedly the new 20-knot battleships of the Italian Navy to which our correspondent refers would be formidable opponents to our armored cruisers; but the latter, because of their extra speed of 2 knots, would be in a position to accept or decline battle at will. Ever since the plans were made public, we have greatly admired these small but swift and powerful ships, and it is quite possible that in this matter, as in some others, the Italian designers have originated a type which will ultimately become general among the navies of the world. The Italians evidently consider that the result of a sea fight will depend more upon the number of blows struck than upon their individual weight; and hence they have sacrificed the heavy 12-inch guns in favor of engines and boiler power, the idea being to provide a ship that could rush in and quickly smother, as it were, an opponent with a number of 8-inch armor-piercing shells, before he could have an opportunity to get in the one theoretically annihilating 12-inch shot.

With regard to the armament of the new battleships, we point out that while the "Rhode Island" and "Virginia" will carry eight 8-inch guns as against four 8-inch carried by the "Georgia" class, the position of the guns of the "Georgia" on the center line of the vessel will enable these ships to deliver, both on the broadside and parallel with the keel, a weight of 8-inch fire equal to that of the more heavily armed vessels. We must remember that in the case of the "Oregon" class it was found that the blast of the 8-inch guns prevented them from being fired dead-ahead or dead-astern, for fear of injuring the officers in the sighting hoods of the 13-inch guns. At the same time, for broadside firing, only two turrets will be available in the "Rhode Island" and "Virginia," the guns on the off side of the ship being masked by the superstructure. The absence of four 8-inch guns, moreover, enables the secondary battery of the "Georgia" class to be increased by at least four 6-inch guns.

In general it may be said that if there has been any error in the designs of our earliest battleships, it has lain in the tendency to overload them with guns; and if this be true, we must naturally look for a somewhat lighter armament relative to the displacement than is found in the ships, say of the "Oregon" type. Our naval constructors are giving more berthing space to crew than formerly, and it is easily conceivable that it might be well worth while to sacrifice a gun or two for the sake of increasing the comfort, health and general good spirits of the crew, upon whom, after all, the fighting efficiency of the ship is dependent.

PROPOSED ABANDONMENT OF PORT ROYAL NAVAL STATION.

The question of the best site for a naval station on the Atlantic coast between Norfolk and Pensacola is now being made the subject of investigation by a special commission, whose report to the Secretary of the Navy will probably be made public within the next few weeks. There is already in existence at Port Royal a naval station which was selected and approved by various commissions which, after an examination of the locality, pronounced emphatically in favor of this site as being the best adapted to meet the requirements of the case. One of these commissions was presided over by Admiral Porter, who was strongly in favor of the site, and a later commission authorized by Congress in 1888, and presided over by Commodore McCann, recommended the establishment at Port Royal of a dry dock, a depot of naval supplies, and a coaling station. In the spring of the present year, the Naval Appropriation Bill, as passed by the House of Representatives, contained an appropriation of $100,000 toward the rebuilding of the dry dock at this station in concrete or stone. The bill went to the Senate and was referred to the Committee on Naval Affairs. While under consideration by this committee, the Secretary of the Navy submitted a letter from Admiral Endicott, Chief of the Bureau of Yards and Docks, in which he strongly deprecated the carrying out of any further work of improvement or extension of facilities at Port Royal, and criticised the site of the dock as being unsuited, for various specified reasons, to the purposes of a naval station, the specified grounds of objection, strange to say, being the very grounds which had been quoted in all previous investigations as being favorable for a station. In the course of his letter he said: "During the year the Mayor of the city of Charleston suggested the propriety of transferring the naval station to that city from Port Royal, stating among other things the facilities for transportation to the interior, the proximity of a large commercial city, the convenience of obtaining at all times skilled labor of all classes, an abundance of fresh water, etc., advantages which are lacking at Port Royal." While the transfer would undoubtedly result in the loss of a great deal of money which has been expended at Port Royal, Admiral Endicott considers the present is the proper time to consider the suggestion of the Mayor.

The Admiral was so much impressed with the wisdom of the Mayor's suggestion, that he gave it hearty endorsement and able advocacy throughout his whole letter. He recommended that the matter be brought to the attention of the Senate Committee on Naval Affairs, and that a board of officers be appointed to "examine into the conditions existing at Port Royal, and the various questions involved in the proposition to remove this station to Charleston Harbor."

Acting upon this letter, the Naval Committee amended the bill by authorizing the Secretary of the Navy to inquire into the advisability of moving the naval station from Port Royal to Charleston, and if he deemed it advisable to do so, empowering him to use $100,000 of the money appropriated in the bill for the Port Royal naval station for the purchase of land for a site at or near the city of Charleston, and to proceed with the building of a dry dock there.

Pending the publication of the report of this commission, it is not for us to say anything one way or the other with regard to the proposed transfer which, of course, has very naturally aroused bitter opposition on the part of the citizens in the immediate neighborhood of the present station. The proposition to "remove" the yard involves the abandonment of the dry dock, machine shops and other buildings at Port Royal, which would represent a dead loss of between one and two million dollars. Moreover, the modern forts at the entrance to the station, which were erected during the Spanish war, will, to a large extent, lose their military value when there is no longer any station for them to defend. The Port Royal site was chosen, presumably, after careful and exhaustive examination, by various expert commissions, in the course of which the advantages of Charleston must surely have received due consideration. At the same time it is possible that the relative strategical advantages of Port Royal and Charleston are not the same under the changed condition of modern naval warfare as they were in the days of Admiral Porter, Admiral Jewett and Commodore McCann.

Among other reasons which are given for the removal of the station it is urged that the absence of social attractions and conveniences in such an out-of-the-way place as Port Royal will render it unpopular with naval officers, both of the line and staff, conveniences which Charleston would readily afford. It seems to us that arguments of this kind are not warranted either by the traditions of the navy or the invariable self-effacement which characterizes our naval officers, when it is a question between personal comfort and the highest interests of the country they serve. The question for the best site for a dry dock and naval repair yard is purely a technical one, and will be decided entirely by questions of accessibility by sea and by land, capabilities for defense, suitability of location with regard to the exigencies of a naval campaign, and possibilities of obtaining at all times the necessary skilled labor.

It is at any rate certain that so complicated and eminently technical a question as this is not to be decided by the preferences of the Mayor of any particular city concerned, although it must be admitted that by quoting the Mayor of Charleston as his leading authority on the advantages of the proposed change, Admiral Endicott has shown a flattering opinion of the judgment of the lay gentleman who holds that distinguished municipal position.

In view of the high authority upon which Port Royal station was originally selected, we think the subject is of sufficient importance to place it before our readers at considerable length, and in the current issue of the SUPPLEMENT we give several views of the yard, together with a history of the selection of the site, and the legislation which has led to the appointment of the present Commission.

CURIOUS FACTS REGARDING MOSQUITOES.

In the SCIENTIFIC AMERICAN for July 7, 1900, appeared an article by Dr. L. O. Howard, in which the distinguishing features of malarial and non-malarial mosquitoes were clearly pointed out. The Department of Agriculture has now issued a monograph by Dr. Howard on the "Mosquitoes of the United States," which, in addition to the critical analysis already published in the SCIENTIFIC AMERICAN, contains matter which is interesting, and little known.

Of the abundance of mosquitoes in all parts of the world, travelers and explorers have given ample testimony. In Lapland and Crimea, according to Kirby and Spence, the number of mosquitoes is enormous. Humboldt has given similar accounts of the conditions at the mouth of the Rio Unare. In the United States mosquitoes are found almost everywhere, from Alaska to Texas, from Maine to California.

A curious and as yet unexplained point, in regard to mosquito existence, is the extraordinary abundance of the insect at certain times upon dry prairies, miles away from water. Although this fact has led Westerners to believe that pools of stagnant water are not necessary for the breeding of mosquitoes, Dr. Howard is more inclined to attribute their presence in dry regions to a greater longevity on the part of the adults of certain species, thus enabling them to live from one rainy period to another. Although adults hibernate and live from November until April or May in the latitude of Washington, they die rather quickly in confinement in the summer. They have been kept in glass jars under various conditions and have thus lived for about eight days. When they have been provided with a piece of ripe banana, renewed every three or four days, they have lived in confinement for two months.

The adult male mosquito does not necessarily take nourishment; and the adult female does not necessarily rely on the blood of warm-blooded animals for food. The mouth parts of the male are so different from those of the female that it is probable that if it feeds at all it obtains its nourishment in a manner quite different from the female. Male mosquitoes are often observed sipping at drops of water; and in one instance a fondness for molasses has been recorded. They have also been known to sip beer and wine. The female mosquitoes are without much doubt plant feeders. It is generally supposed that a highly nutritive fluid is necessary for the formation of the eggs; but the supposition is emphatically denied by Dr. Howard. There are in this country enormous tracts of marshy land into which warm-blooded animals never find their way, and in which mosquitoes are breeding in countless numbers. Instances have been recorded in which mosquitoes have been observed feeding on boiled potatoes and watermelon rinds. That they do occasionally feed upon other than warm-blooded animals

has been proven time and time again. They have been observed feeding upon the chrysalises of butterflies and puncturing the heads of young fishes.

How far do mosquitoes fly? The question is of no little importance, for if mosquitoes fly great distances, exterminative work on the breeding places near a house or community is of slight avail. Most writers agree that mosquitoes will not rise or take flight when a brisk breeze is blowing, and that even in light winds they keep close to the ground. That mosquitoes do cling to the branches of trees during a wind has often been observed. They are so frail in structure that it seems impossible that they should be carried great distances by land breezes; for a long flight presupposes an ability to battle against wind which so feeble a creature cannot possess. But, although mosquitoes may not be carried along by winds, they are sometimes transported by railway trains to the despair of many country resorts. Mosquitoes are carried in cars for great distances and will start to breed in localities where mosquitoes are rare.

It is a much-mooted question among entomologists whether or no mosquitoes can breed in mud. Dr. Howard's experiments and investigations tend to show that the larvæ will live in wet mud for some little time and that they will even transform after water has been added. In no case were larvæ revived after the water had been drawn off for more than forty-eight hours.

ANOTHER ELECTRIC RAILWAY FOR LONDON.

Since the advent of the Central Electric Railway in London, innumerable schemes have been formulated for a further means of rapid intercommunication with all parts of the metropolis. Some have been practicable and useful, while others have been simply due to the imagination of fertile brains. But now a scheme has been formulated, which, if reduced to practice, would prove of inestimable benefit to everyone, both Englishmen and foreigners. It is proposed to link all the termini of the various trunk lines in London together by means of an electric railway. Unfortunately, London does not possess one huge depot in which all the railways converge, and thus obviate much inconvenience to those passengers who desire to change from one system to another, but they are distributed throughout the metropolis, and in some cases are as much as four or six miles apart.

With a view to surmounting this difficulty, and to bring the termini into close communication, two leading London engineers have drawn up the scheme in a terse and practicable manner. Their idea is to establish a central station in Piccadilly Circus, and from there to radiate tracks direct to the terminus of each trunk line, at a depth of 100 feet, or more, below the surface. When a train arrives at a southern terminus with passengers desiring to cross London to a terminus in the north, the steam locomotive will be simply detached at the southern terminus, the train lowered bodily by a huge electric lift to the underground system, an electric locomotive attached, the train hauled to the northern terminus, raised to the higher level again by lifts, another steam locomotive attached, and the passengers conveyed to their destination without experiencing all the inconvenience and trouble of changing their carriages.

It is estimated that a total length of 11 miles of railway will be necessary to connect all the termini together, while about 40 tunnels would ramify from Piccadilly. In addition to the central station there will be 17 local stations. One of the objects of the railway will be the rapid transit of fruit and fish to the markets of Covent Garden and Billingsgate respectively, the produce for which is at present conveyed through the streets. The Covent Garden station will be a great boon. About 1,600,000 tons of fruit and vegetables are carried to this market every year, and yet there is no railway facility to Covent Garden. Another station will be established at the General Post Office for the rapid conveyance of the mails to the trunk lines termini. The greatest beneficial effect of the railway will be that it will relieve the existent too densely crowded streets of the greater part of the slow vehicular traffic. A company is being formed for the purpose of obtaining the necessary Parliamentary powers, and also to construct the railway. It is estimated that it will cost about $150,000,000 to realize the scheme, but already the idea has found wide financial support.

MALARIAL INFECTION ON THE EAST COAST OF AFRICA.

The Malaria Committee of the Royal Society of London have received some startling information from Drs. Christophers and Stephens anent malarial infection on the east coast of Africa. According to their reports, the native races, and particularly the children, are extensively responsible for the infection, assisted by the mosquito. These two doctors state that they have found no native house the children in which were free from infection. The blood of the infants contains just what is essential for the transmission of human malarial poison by the intervention of the mosquito.

By some occult means the children experience an interesting and perfect immunity from the effects of malaria. Young babies have been proved to be the most infectious, the inherent presence of the malaria gradually decreasing as the child grows older, and in children over twelve years of age, cases of infection were rare—the majority, on the other hand, appearing rather healthy. The huts of the native villages are infested with the mosquitoes, which during the daytime secrete themselves in all the nooks and crannies. A white man would enter a native hut, and, from a cursory inspection, would conclude that it was safe. But when the night came on, and the mosquitoes issued from their hiding places, the stranger would be attacked by the insects and would almost invariably contract the disease. Dr. Christophers contends that it is absolutely unsafe to sleep within one hundred yards of a native village. One of the observers made the experiment of sleeping close to a village without a net, and soon experienced the discomforts resulting from the attacks of the mosquitoes. By displaying every precaution, however, a white man may sleep night after night without experiencing any ill effects.

THE "DEUTSCHLAND" BREAKS TWO RECORDS.

The "Deutschland," of the Hamburg-American Line, made two records on her last westward trip, which ended on September 1. She made the voyage from Cherbourg, a distance of 3,050 knots, in five days twelve hours and twenty-nine minutes. This beats the "Kaiser Wilhelm der Grosse's" best record made November 15, 1899, by four hours and fifty-eight minutes. An average speed of 23·2 knots per hour was maintained by the "Deutschland" during the entire trip, which was a fraction better than the promise of her builders. The record of the daily runs was 337, 566, 570, 570, and 584 and 423 knots. The "Deutschland" exceeded by 4 knots the greatest distance ever sailed in twenty-four hours. The "Kaiser Wilhelm der Grosse" made 580 knots on one occasion. The "Deutschland" now holds six records. First, the voyage from New York to Plymouth on August 14, the time being five days eleven hours and forty-five minutes, which was better by two hours and twenty-one minutes than her previous record of July 24. Second, her voyage from Plymouth to New York, completed on July 12, in five days sixteen hours and forty-six minutes, being her maiden trip. Third, her voyage from Cherbourg to New York made in five days twelve hours and twenty-nine minutes. Fourth, her best hourly average 23·32 knots recorded for the voyage ended at Plymouth August 14. Fifth, best day's run 584 knots on August 30. Sixth, the best time for a maiden trip made between July 6 and 12. On the last voyage, the engines exerted 36,000 horse power and 600 tons of coal were burned per day. The engineers of the "Deutschland" believe that the ship has "found herself" and that in a short time she will break more records.

THE GREAT ARARAT ASCENDED.

The Ararat Mountains in Armenia comprise two peaks situated seven miles apart. They are known as Great and Little Ararat, and are respectively 17,260 and 14,320 feet above the plain. They partially belong to three countries, Russia, Turkey and Persia. The mountains are covered on the tops with perpetual snow, ice and glaciers. The summit of Great Ararat was reached in 1829 by Prof. Parrot, and on September 2, 1900, a member of the Russian Geographical Society named Peoggenpohl ascended the peak with a considerable party. The difficulties of the ascent are very great, and his successful expedition will be welcome news in geographical circles. Ascents are rare, having been made in 1834, 1843, 1845, 1850 and 1856. Little Ararat is even more difficult to climb, as its declivities are greater and steeper, its form being almost conical. It is believed to be the spot where the ark rested, but there is a tradition that Mount Judi in southern Armenia was the spot. The mountain is of volcanic origin and was in eruption in 1785, and in 1840 there was a vast discharge of sulphurous vapors from its sides, and a tremendous earthquake shook the surrounding country. There is considerable literature devoted to the mountain.

THE DUKE OF ABRUZZI'S EXPEDITION REACHES THE HIGHEST ALTITUDE.

All those who are interested in Arctic exploration will be glad to learn of the return of the "Stella Polaris" with the Duke of Abruzzi's Arctic exploration party. The sledge party reached a point farther north than Nansen, 86° 33′ and was gone 104 days. The "Polaris" was caught fast in the ice and held for eleven months, stoving in her sides and inflicting other damage. The members of the principal sledge party suffered the usual hardships which fall to the lot of the Arctic explorer, being forced to eat their sledge dogs for food; three of the party perished. Reports, meager in their details, have been received from Tromsoe. The Duke's equipment was admirable and he did not attempt to reach the pole by the Nansen plan of approaching by the open sea or by drifting, but relied upon sledge trips. The scientific value of the Duke's expedition will probably be considerable, as the members of the party were provided with the best instruments obtainable.

SCIENCE NOTES.

The small planet No. 444, which was discovered by M. Coggia at Marseilles on March 31, 1899, has been named Gyptis.

The presentation of the awards of the Paris Exposition was an elaborate ceremony. A number of decorations of the Legion of Honor have been distributed.

The sewers of Munich discharge their contents directly into the river Iser. This river flows so rapidly and its volume is so considerable, that there has been no sensible deterioration in the river water. As a precaution, however, the building of a catchpit to remove heavier matter is contemplated.

Dr. R. Uhlenbuth describes a simple method of preparing free hydroxylamine, which consists in heating hydroxylamine phosphate gently under reduced pressure. It is stated that the hydroxlyamine distills over in a state of extreme purity, the distillate solidifying if the receiver be surrounded by melting ice.—Annalen.

The panorama of the Battle of Champigny, by the great French military painters De Neuville and Detaille, has had a checkered career. When the panorama ceased to pay, it was cut into pieces and the groups were sold separately. The central scene was exhibited in several French towns and was finally pawned. It is at present in the section known as "Old Paris," at the Exposition.

MM. Desgrez and Balthazard state that they have discovered a method of regenerating air in confined spaces. They have submitted to the Academy of Sciences aluminium diving dresses weighing 25 pounds. They state that the diver can move in this suit for hours under water without drawing air from the surface. The principal regenerating agent seems to be sodium dioxide. It is said that the invention is applicable to submarine work, poisonous atmospheres in mines, submarine warfare, and certain chemical industries.

E. Gain has examined the structure of the embryo of grains of wheat and barley obtained from Egyptain mummy cases, and finds that although the grains have undergone but little change in external appearance, and the reserve substances have retained their chemical composition, the chemical composition of the embryo has been completely altered, and it is no longer capable of development. The dormant life of the seed must long ago have expired; and M. Gain regards this observation as entirely disposing of the apocryphal statements that these seeds can germinate after thousands of years.—Comptes Rendus.

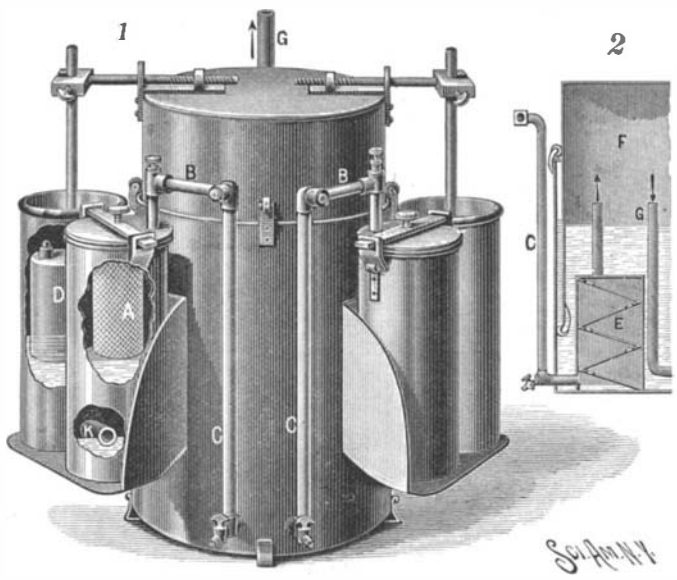
After the dispersion of a French exploring expedition under M. Blanchet in the Western Sahara, and the imprisonment of its leaders by the Chief of Adrar, the French public must have learnt with satisfaction that the three military expeditions dispatched to Lake Tsad effected their junction on April 21 at Kusuri on the Shari. Lieut. Joalland, of the disastrous expedition originally sent out under Capt. Voulat, was the first to arrive. M. Foureau and Major Lamy followed; and when M. Gentil, coming from the south, joined their forces, the French were in a position to bid defiance to the usurper Rabah of Bornu, whom they defeated in a pitched battle. Rabah himself was wounded, and, after the fashion of Duncan of Knockdunder, a French tirailleur cut off his head. Major Lamy, the leader of the united forces, was mortally wounded.

The uses of monochromatic light in optical experiments are so numerous that considerable interest attaches to the paper, on the means of producing such light, by MM. Charles Fabry and A. Pérot in the Journal de Physique for July. After pointing out the disadvantages of sodium light on account of the proximity of the D lines, the authors divide the methods of producing a beam of monochromatic light into two, viz.: (1) Simplification of a beam of white light, and (2) use of light emitted by a gas. Under the later method are included (*a*) flames; (*b*) gases or vapors rendered luminous by electricity; (*c*) induction sparks; and (*d*) the electric arc. In connection with (*b*) it is found that the quality of the rays depends on the nature of the current exciting them, and the authors consider the use of (1) a coil with secondary condensers; (2) alternating currents; (3) continuous currents. Of these methods the last is the best, though the second is better than the first. While the results of these investigations cannot be briefly summarized, we notice that the authors have shown the possibility of improving the action of Michelson's tubes, of using a modification of the mercury arc of Arons as a source of monochromatic light of great intensity, of using the rays of a certain number of metals for interference observations where the difference of path is considerable, and, by measuring the wave-lengths, of adding a number of new fixed points on the spectrum. The paper concludes with a table of wave-lengths determined by MM. Pérot and Fabry, and comparison with the determinations of Michelson.

AN AUTOMATIC ACETYLENE-GENERATOR.

The apparatus which we illustrate herewith is an acetylene-generator of improved form, invented by Mr. Oliver D. Fry, of Altoona, Pa. Fig. 1 represents the apparatus in perspective. Fig. 2 is a section of the gasometer. Gas is produced in two generator-casings, *A*, containing water to decompose the carbide supported in a removable basket within the upper end of the casing. The removable lid of each generator-casing is held on a valved pipe, *B*, connected with a pipe, *C*, to conduct the gas to the gasometer, *F*. The pipe, *C*, as Fig. 2 shows, opens into a separator, *E*, submerged in the water of the gasometer tank and provided with a zig-zag partition, by which the gas is sufficiently retarded to condense any moisture. From the gasometer, *F*, a stand-pipe, *G*, conducts the gas to the service-pipes. On the top of the gasometer, bearings for horizontal screw-rods are secured, which rods are adjustably clamped to vertical rods, each carrying at its lower end a displacer, *D*, in the form of a vessel inclosed in an outer receptacle connected by a pipe, *K*, with the generator-casing, *A*. Normally, each carbide-basket is arranged with its lower end above the water in the generator-casing. But when the supply of gas is withdrawn from the gasometer, the bell, *F*, falls, carrying with it the displacers, *D*, thereby forcing the water in the generator-casings into contact with the carbide. As the bell rises again under the pressure of the fresh supply of gas, the displacers are raised out of the water, the level of which falls away from the carbide. The operation is entirely automatic.

By means of the screw-rods, the displacers can be adjusted up or down to regulate the supply of gas to the desired number of burners. The displacers can be filled with water to increase the weight on the bell, if it be so desired.



FRY'S ACETYLENE GENERATOR.

PARIS EXPOSITION—MODELS IN HUNGARIAN SECTION, ILLUSTRATING ENGINEERING WORK ON LOWER DANUBE.

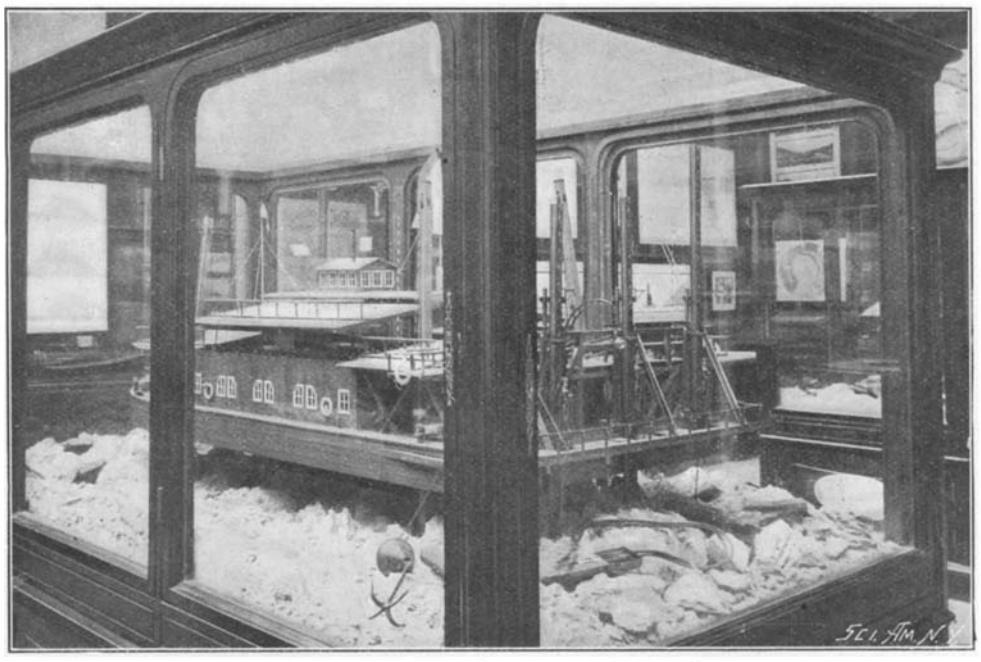
The Hungarian section of the Civil Engineering Palace contains a number of models and plans which illustrate a very important piece of engineering work, carried out by the Hungarian government; by this means, the lower portion of the Danube, in which navigation has been heretofore almost impossible, has been brought to the condition of a navigable river. The extent of this great work is shown by the numerous plans and views, and by the models of the various boats used, some of which are shown in the illustrations.

The Lower Danube, in spite of the size and importance of the countries through which it passes, has been heretofore scarcely navigable on account of the rocky obstructions which occur throughout a considerable portion of its length. The question has been considered ever since the time of the Romans, who tried to pass around the rocky bank called the Prigrada by constructing an auxiliary channel at the side; this work, which was commenced under the Emperor Trajan, was afterward abandoned for various reasons. Matters remained thus until the present century, when Count Stephen Szechenyi made some preliminary in this direction, but was not able to proceed with an undertaking of this magnitude. In 1871 it was the subject of the International Conference at London, which named a commission to carry out the project; this was interrupted by the Turco-Russian war and other conflicts. The Congress of Berlin, of 1878, took up the matter, and it was arranged that the Austro-Hungarian nation should execute the project; and by an agreement between Austria and Hungary, the latter took up the work. M. de Baross, the Hungarian Minister of Commerce, had an elaborate set of plans drawn up in 1889 by a technical staff, after which the work was carried out by a company of capitalists and engineers. It was begun in August, 1890, and finished in September, 1898.

The obstacles to navigation of the Lower Danube consist of a series of cataracts which succeed each other in great numbers and different forms. In some of these, rapids are formed by the shallow rocky bed, over which the current passes with great speed; in other cases the projecting rocky banks narrow the bed of the river and form rapids. The object of the work is thus to deepen the shallows and modify the too rapid current so that navigation will be practicable at all stages of water. In the first case, channels were dug in the rocky bottom of 180 feet average width and 6 feet below low water level, this depth being sufficient for boats of 1,000 tons. In the case of projecting banks, the rapidity of the current was diminished by the construction of stone dikes or jetties at high-water level, which distributed the fall of water over a longer section.

The cataract of Stenka is formed of granite rocks, which bar the Danube throughout its whole width of 4,800 feet, and also of rocky projections which emerge from great depths. To render this section navigable, a channel 5,400 feet long was dug in the middle of the bed, and from this were taken out more than 18,000 cubic yards of hard rock. The next rapids are those of Kozla-Dojke, extending over a length of 2½ miles, and are formed by two rocky banks which extend nearly across the bed of the river, here 2,400 to 2,700 feet wide. The two banks obstruct navigation at low water, and to overcome the difficulty a channel 10,500 feet long was dug, which clears both banks; for these, 60,000 cubic yards of rock were removed. The cataract of Izlas-Tachtalia has in one part a bed of rock running across the entire width of the river, which causes rapids of great violence; farther down are the sharp points of the rocky bed called the Tachtalia, then a group of projecting rock, the "Wlasch." Through these rocks has been pierced a channel near the Servian bank of the river, 10,500 feet long. The amount of rock taken out exceeds 32,500 cubic yards. From this cataract a succession of rock-banks continues to the Greben, a high rock which advances into the bed of the river and narrows it to 1,260 feet; below the Greben, the river suddenly enlarges to 6,600 feet, and the water pours into this basin with a speed so great that boats can pass only with the greatest effort. Here the great rock has been cut down to mean water level for a width of 450 feet, thus enlarging the river bed to 1,710 feet with a great diminution of the current, and to render the fall less abrupt a wall has been constructed from the Greben to Milanovac, or 3½ miles, keeping the width constant at 1,710 feet for this distance. From the Greben 330,000 cubic yards of rock have been cut, beside a channel 3,700 feet long, containing 13,500 cubic yards. For the walls over 500,000 cubic yards of rock have been used.

The most important of the cataracts is that called the "Iron Gates"; it is a chain of schistic rock, the Prigrada, which seems to unite the Carpathian and Balkan chains. It traverses the Danube and forms a veritable rocky dam, with broken points, over which the river falls with violent whirlpools. Here has been established a channel, running along one side of the river, and separated from the main bed by an outer wall; the channel is 5,160 feet long and 225 feet wide at bottom, and 9 feet below low water level. The work was executed on a dry bed, or in still water, by the aid of a provisory dam; a channel of the same depth was also dug as far as Orsova, a distance of 6 miles, also an embankment 5,400 feet long to guide the water into the channel. For the whole of the work at the "Iron Gates," 115,000 cubic yards of rock were removed under water and 370,000 cubic yards from dry bed. For the construction 280,000 cubic yards of rock were used and 270,000 of mixed filling material, not counting the revetment of the walls over a surface of 65,000 square yards.



MODEL OF DRILL BOAT, USED IN IMPROVING THE DANUBE.

MODEL OF SOUNDING BOAT, USED ON THE DANUBE.

The models shown in the illustrations give an idea of the different types of boats used in the execution of this great work. It was at first necessary to lay out an exact chart of the river bed, obtained by measurements, so as to calculate the mass of rock to be removed and the best method of operation. The readings were taken by a special boat constructed for the purpose. The rock was removed from the channels by blasting, using boats provided with Ingersoll drills for the mines, or by boats provided with rock-cutters of the Loboritz system. The broken rock was taken out by a large dredge of Scotch make, the "Vaskapu," besides smaller dredges, some of American make. The last operation was made by the "Universal Boat," which explored the bottom and at the same time served as rock-cutter and dredge.

The sounding boat, shown in the illustration, is composed of a platform about 60 feet long and 30 feet wide, mounted on two pontoons. It is provided with six pairs of longitudinal openings, spaced 3 feet apart, each pair of openings lying between two rails. The rails support two carriages which carry vertical graduated bars, these making the four angles of a square 3 feet on a side. The bars may be moved in a vertical direction by pulleys, and are made strong enough not

to be deviated by the rapid current. Upon the carriage is a vernier for each of the bars, placed at a determined height, 4·8 feet above the head of the rail. The boat being solidly fixed in the bed of the river by vertical posts, the rail-level is taken with reference to a given point on the bank, and then by the vernier readings of each of the vertical bars, the exact depth of the bottom is known, and the amount of rock to be removed is calculated. For each position of the carriage four points are thus obtained, and the boat has a capacity for fifty positions of the carriage. After the plans have been thus drawn up and the calculations made, the rock is removed by blasting or by vertical cutters.

The boat shown in the illustration is used to carry the drills for the mines; the holes are pierced in the rock from 1 to 2 yards deep. The boat is solidly fixed by four vertical supports, two in front and two in the rear. It is kept in place by steam or hydraulic pressure, the boat being lifted a little above the water level. This boat is made in two types. In the model shown at the Exposition the drills are placed in the rear in a single line, moving upon rails, and thus one line of holes perpendicular to the channel are pierced in one position of the boat. In another type, all the drills are placed upon a movable carriage which may be displaced at will. A section of the cartridge used for the blasting is shown in front of the boat. When the mines of one line of holes are charged, the vertical supports of the boat are lifted and the boat retires a certain distance. All the mines are exploded at once, and the boat then comes back to drill a second set of holes from 5 to 10 feet from the former. The rock is also removed by rock-cutting boats, which carry a heavy cutter in the form of an iron bar of square section, terminating in wedge-shaped form. The cutting edge is formed of a steel piece inserted in the middle. The bar is lifted to a certain height by a steam windlass and let fall to cut the rock. It is supported upon a derrick 40 feet high.

The Hungarian government has thus successfully accomplished the work entrusted to it, and has received expressions of satisfaction from all the sovereigns of Europe. The navigation of the Lower Danube, which before was carried on under great difficulties, has now been rendered easy, and boats may pass even at low water. As an example, before the work was carried out, the boats of the Lower Danube, loaded generally to a draught of 5½ feet, could not pass the "Iron Gates" during the season, March 1 to November 30, but for 91 days on an average. At present they are able to pass for 271 days, a gain of 180 days for navigation. This has naturally resulted in an enormous increase of traffic and a corresponding benefit to the surrounding countries.

PILOT BOAT WRECKED BY A WHALE.

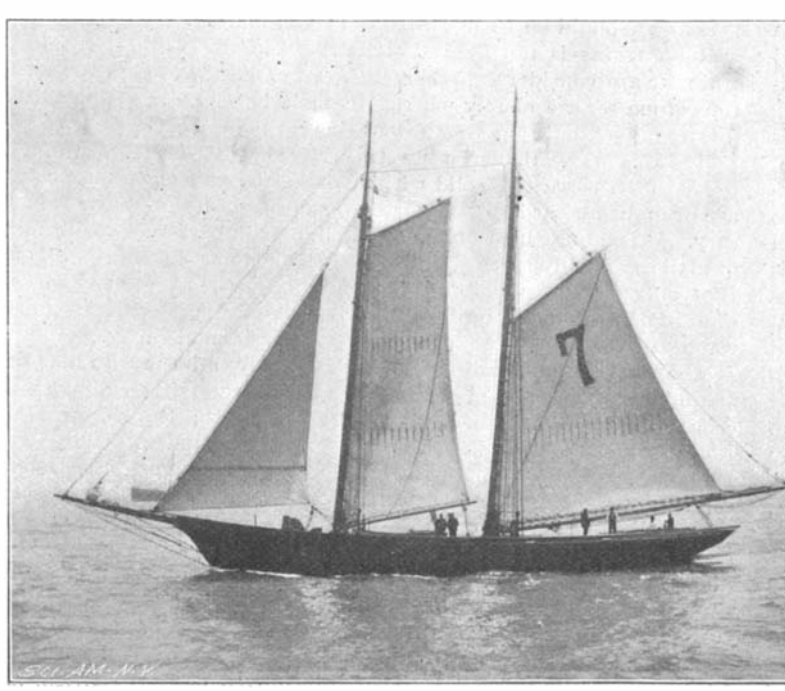
The wreck of the pilot boat "Bonita," on the night of July 20, off San Francisco Bay, was an incident, if not unparalleled in maritime annals, sufficiently rare to make it worthy of record.

The "Bonita" was one of the finest of her class, and since 1892 has been stationed off the Golden Gate, intercepting vessels bound for that difficult and fog-infected harbor.

On the night of the wreck the officers and crew, with the exception of the man at the wheel, were just at supper. The fog was so dense that objects a cable length away were invisible. Suddenly a shock of sufficient violence to knock the men off their seats was felt throughout the ship. Supposing that a collision had occurred, the crew rushed to the deck, but no other vessel was in sight. Sounding the pumps, it was discovered that the "Bonita" was sinking, and at the same time one of those enormous gray whales loomed up on the side of the craft and disclosed the cause of the accident. The "Bonita" remained afloat long enough to allow the crew time to secure their effects and launch their boats. They were subsequently picked up by incoming vessels. The wreck occurred about six miles southeast of the Farallones, and now lies in six fathoms depth of water. She may be raised, though the operation will be difficult on account of the strong currents at this point.

The California gray whale is the largest of the species, and is seen on the California coast from November until May. Its favorite haunt seems to be at the entrance of San Francisco Bay, where it is observed often in large numbers. One caught in this vicinity forty years ago measured 97 feet in length. Their weight is prodigious. Their scientific designation is sibbaldius sulfureus.

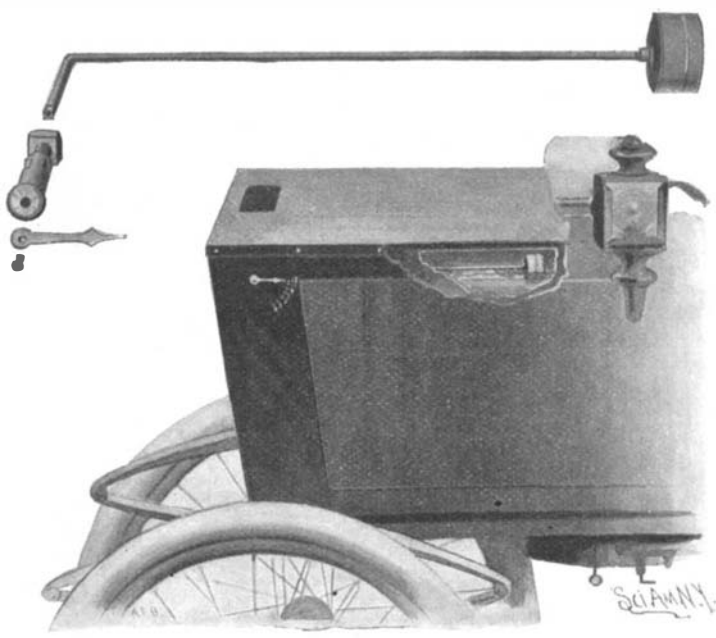
The "Bonita" was built in 1892 and was of 75 tons register. Her dimensions were 88 feet over all, 23 feet breadth and 9·8 depth. Her crew numbered five. Four pilots were aboard when the wreck occurred.



PILOT BOAT SUNK BY A WHALE.

A SIMPLE INDICATOR FOR LOCOMOBILE WATER-TANKS.

Steam-carriages are unprovided with any means for readily ascertaining the level of the water in the supply tank. The ordinary method of roughly gaging the water by thrusting a stick in the tank has its disadvantages, chief among which may be mentioned the necessity of first removing the hot tank-cover with a cloth. For obviating this difficulty, a member of the SCIENTIFIC AMERICAN staff, who has for some time driven a locomobile, has devised a very simple expedient which has proven remarkably efficient. The accounts of automobile improvements which we have published in past numbers have met with sufficient approval to justify the publication of a brief description of this simple indicator.



A SIMPLE WATER-INDICATOR FOR LOCOMOBILES.

To the longer leg of a brass rod, bent at right angles, a brass float is secured which rises and falls with the water in the tank. The short leg of the rod passes through a brass sleeve which bridges the space between the carriage body and the tank, and which is held in place by a nut screwing upon the threaded end of the sleeve. The short leg of the rod projects from the sleeve, and its squared outer end receives a finger or pointer which plays over a scale graduated in gallons. As the float falls in the tank, the pointer is turned a corresponding distance and indicates on the scale the number of gallons of water still left in the tank.

The indicator can be made even by a man of no great mechanical skill. The float pictured consists merely of an ordinary brass box, 1¾ inches in diameter at the ends and 1¼ inches high, the cover being soldered to the body to form an air-tight joint. The brass rod is likewise soldered to the box. It will be observed that all the parts, including the sleeve, are made of brass to resist the action of the water. The pointer is made preferably removable, so that it can be detached whenever it is found that the float is not absolutely air-tight.

Krupp Iron Works.

The annual report of the Chamber of Commerce for the district of Essen contains statements concerning the cast-steel works of Frederick Krupp. These comprise the following: Cast-steel Works, at Essen; Krupp Steel Works, formerly F. Asthöwer & Company, at Annen, in Westphalia; the Gruson Works, at Buckau, near Madgeburg; four blast furnaces at Duisburg, Neuweid, Engers, and Rheinhausen (this latter consists of three furnaces with a capacity for each of 230 tons per twenty-four hours); a foundry at Sayn; four coal mines (Hanover, Saelzer, Neuack and Hannibal), with interest in other coal mines; more than 500 iron mines near Bilbao, in northern Spain; shooting grounds at Meppen, with a length of 10⅝ miles and a possibility of extension for 15 miles; three ocean steamers, several stone quarries, clay and sand pits, etc. In addition, the firm of Frederick Krupp operates the Ship and Machine Stock Company Germania, at Berlin and Kiel, under contract, says Consul General Guenther.

The most important articles of manufacture of the cast steel works at Essen are cannons (up to the end of 1899, 38,478 had been sold), projectiles, percussion caps, ammunition, etc.; gun barrels; armor plates and armor sheets for all protected parts of men-of-war, as also for fortifications; railroad material, material for shipbuilders, parts of machinery of all kinds, steel and iron plates, rollers, steel for tools and other purposes. The steel works in 1899 operated about 1,700 furnaces, forge fires, etc., about 4,000 tool and work machines, 132 steam hammers of from 200 pounds to 5,000 metric tons force, more than 30 hydraulic presses (among them 2 of 5,000 tons each, 1 of 2,000 tons, and 1 of 1,200 tons pressure), 316 stationary steam boilers, 497 steam engines with an aggregate of 41,213 horse power, 558 cranes of from 400 to 150,000 tons lifting power. During the last year, the iron mines yielded an aggregate of 1,877 tons of ore per day. The coal production from the mines belonging to the Krupp Company (excepting the Hannibal) amounted, on an average, to about 3,738 tons for each working-day.

The consumption of coal and coke in 1899 was as follows: In the cast-steel works at Essen, 952,365 tons; in the other works and on the steamers of the company 622,118 tons; in all, in round numbers, 5,000 tons per day. The consumption of water at the cast-steel works in 1899 was 15,018,156 cubic meters, which equals about the consumption of the city of Frankfort, with 229,279 inhabitants. The consumption of gas in the steel works at Essen was 18,836,050 cubic meters in 1899.

The electrical power plant of the works at Essen has three machine houses, with six distributing stations, and supplies 877 arc lights, 6,724 incandescent lamps and 179 electric motors.

For the traffic of the works, railroad tracks of standard gage of about 36 miles are laid, which connect with the tracks of the main railroad station at Essen. Sixteen locomotives and 707 cars are operated on the grounds. In addition, there are narrow-gage tracks of 28 miles, with 26 locomotives and 1,209 cars.

The telegraph system of the steel works has 31 stations, with 58 Morse telegraphic instruments and 50 miles circuit. The telephone system has 328 stations, with 335 telephones and a circuit of 200 miles.

On April 1, 1900, the total number of persons employed in the different works was 46,679, viz., 27,462 at Essen, 3,475 at the Gruson Works of Buckau, 3,450 at the Germania Works at Berlin and Kiel, 6,164 in the coal mines, and 6,128 at the blast furnaces and on the testing-grounds, at Meppen, etc.

From Europe to America Overland.

Reuter's Agency is informed that Mr. Harry de Windt is leaving for the purpose of crossing Siberia to the Behring Straits, and thence over the straits and via the Mackenzie River to Winnipeg and New York. Mr. de Windt attempted a land journey from New York to Paris in 1896, but was captured and imprisoned by the Tchukehis near East Cape with such results to his health that the project had to be abandoned. This time he will make the journey in the reverse direction. Proceeding from Paris, he will leave Moscow on August 12, and will travel by the Trans-Siberian Railway to Irkutsk. Thence he will go to Yakutsk to make final preparations for his journey, which will occupy about 18 months. The explorer will carefully avoid the natives of Ouinvadjek, on the Behring Strait coast of Siberia, who gave him so much trouble on the last occasion, and will proceed direct to the small settlement of East Cape, which is much to the southward of his previous route. There he will remain for four months, when he will be called for by an American whaler and will be conveyed across the straits to the Mackenzie River. Mr. de Windt will be accompanied by his servant, Harding, who has been his sole companion on most of his previous expeditions.

THE GREATEST BUSINESS CONCERN IN THE WORLD.

The postal establishment of the United States is the greatest business concern in the world, handling more pieces of mail, and employing more men and women than any other government or corporation. The immense size of the country, the lack of concentration of the inhabitants in a few large cities, all help to make the Post Office service of the first magnitude, and, as a matter of fact, only one corporation, a combination of railways, earns and disburses as much as the Post Office Department. Probably no branch of the government service comes into as close contact with the average citizen as the Post Office. The postal service is pre-eminently one of detail, and it may, perhaps, be interesting to take the report of the Posmaster-General and analyze some of the figures.

Some idea of the wonderful perfection and system which makes the service possible may be obtained when it is stated that a letter can be sent from Florida to the Klondike, a distance of over 7,000 miles for two cents, thirty days being consumed in its transmission. If it were carried by courier the time would not be lessened and the cost would be increased to something like $300. It is this remarkable cheapness which makes the service so interesting, for, of course, on this hypothetical trip of the letter, its delivery in the gold fields costs much more than was received for its transmission, but the government makes a handsome profit on much of the first-class matter; enough, in fact, almost to make good the deficit caused by transporting inferior classes of matter.

According to the report of the Second Assistant Postmaster-General for the fiscal year ending June 30, 1899, there were 34,298 routes of domestic mail service in operation upon that date. The total length of these routes was 496,948 miles, or more than a round trip between the earth and the moon, as is shown graphically on our front page. The number of miles traveled per annum is 445,744,845 miles, or more than two round trips to the sun. The annual rate of expenditure for the transportation of the mail is $53,076,413. The rate of cost per mile of length of the route is $106.80. The rate of cost per mile traveled is 11·90 cents; the average number of trips per week is 8·62.

The inland service can be divided into ten classes, and a comparison is made in our engraving of the length of the various routes. By "star route" is meant a route where the means of transportation is other than railway, steamboat, street car, or pneumatic tube. There are 22,482 star routes and their length is 269,452 miles. The annual rate of expenditure for this service is $5,114,943. The annual travel is 132,068,807 miles. The daily travel for 365 days is 361,830 miles, or seventeen times around the world. It is upon the star routes that much of the romance of the Post Office Department rests, and many of the carriers have performed heroic deeds.

Next on our diagram comes the railway service, which amounts to 176,726 miles, divided among 2,617 routes. The annual rate of expenditure for carrying the mails on the railroads is $31,942,150. This does not include the salaries of 8,388 railway post office clerks, who receive the sum of $8,610,732. The annual travel upon the railroads is 296,782,270 miles. Dividing this total by the number of days we obtain the daily travel on railroads, which amounts to 813,000 miles, or thirty-one trips around the world. There were handled by railway postal clerks during the year 7,118,422,840 pieces of first-class matter, and 6,233,569,885 of all other classes of matter, making a total of 13,351,992,725 pieces, which includes 519,870,465 pieces of city mail separated in railway post offices. In addition there were handled by the railway postal clerks 17,537,058 packages, cases and pouches of registered mail. With 1,312,388 errors made by the clerks in distributing this matter, there were over 10,000 correctly forwarded pieces of mail to every error made, constituting a remarkable record. There were 799 casualities during the year to railway postal employés, and of this number 6 were killed and 50 seriously injured.

The number of routes of steamboat mail carriers is 178, and the length is 31,169 miles. The annual travel amounts to 4,387,028 miles and the annual rate of expenditure is $550,454. The street car service amounts to 1,926 miles and includes 267 routes. The annual travel is 4,978,130 miles and the rate of expenditure is $275,448. The pneumatic tube service is only 8·05 miles in length, so that it would hardly show upon our diagram. The pneumatic tube service cost $222,266, and it is confined to the cities of Boston, New York, Brooklyn and Philadelphia. The service has proved highly efficient and has done away with many thousands of miles of wagon service. Letters for branch offices can be forwarded at once by the pneumatic tube instead of being held, as formerly, for the next regularly scheduled wagon or car trip. The labor of closing, recording, and verifying pouches is also done away with. There are several minor means of transportation known as special office routes, mail messenger routes and wagon routes in cities. While some of them are very extensive they do not call for special attention.

The question of weight naturally occupies the second place in interest. Before discussing this, however, it is necessary to consider briefly the various classes of postal matter. "First-class" matter includes letters, postal cards, and anything sealed or otherwise closed against inspection. While the weight of first-class matter is not very great, at the same time it furnishes the greater portion of the postal revenue. "Second-class" matter includes all newspapers, periodicals, and all matter exclusively in print and regularly issued at stated intervals, as frequently as four times a year. This forms the bulk of all mail matter carried and furnishes only a small percentage of the revenue. "Third-class" matter includes printed books, pamphlets, circulars, etc., and does not form a very large portion of the weight carried, although it furnishes almost twice as much revenue as enormously heavier second-class matter. "Fourth-class" matter is all mailable matter not included in the preceding classes, embracing merchandise and samples of all kinds. The weight of first-class matter carried amounts to 128,517,992 pounds. The postage paid amounts to $65,987,732. The total number of letters and other pieces that are sent at letter rates is 2,917,000,000. In addition to this there were 98,092,000 dead-head and "official business" letters sent through the mail as well as 573,634,000 postal cards, making the total number of first-class pieces of mail matter 3,588,726,000 pieces. There are 9,804,729 pieces of first-class matter mailed daily. This would make a pile 39,219 feet high, or more than 7 miles high, not allowing for the compression caused by the incumbent weight.

In second-class matter the total number of pieces mailed amounted to 2,173,715,000. This is, however, only an estimate, though an official estimate; it is, undoubtedly, very much larger. The total weight of matter paid at pound rates by publishers was 352,703,226 pounds. In addition to this, 62,241,700 pounds were transmitted free, and 25,289,355 pieces of transient matter paid for by stamps were also transmitted, making a grand total of 440,234,281 pounds. The total postage paid amounted to $5,091,322, and, notwithstanding the great weight of the material carried at pound rates, it paid only $3,527,032 of this amount. The enormous discrepancy between the weight carried and the postage paid on second-class matter is admirably shown by our diagram. The transportation of second-class matter at such an excessively low rate was, of course, the cause of the postal deficit of $6,610,776. There are many abuses connected with second-class mail, such as the mailing of novels, trade organs, etc., which conform to the letter, but not to the spirit of the laws. If every Postmaster-General would make strenuous efforts to rectify these abuses, it would put this department on a paying basis. Up to the present time, however, there does not seem to be any prospect of relief.

The weight of third-class matter carried is 68,227,169 pounds, and the number of pieces mailed amounts to 747,695,000 pieces, and the postage paid is $10,093,882, from which it will be seen that the amount of postage paid in this class is thoroughly adequate to produce a surplus.

The weight of fourth-class matter is 21,776,347 pounds. The number of pieces mailed is 66,174,000, the postage paid being $3,421,181. The weight of foreign mail carried is 7,760,377 pounds, and the cost is $2,546,806.

The figures which have just been shown make imposing totals. The number of pieces mailed in the fiscal year which we are considering is 6,576,310,000. If these pieces of mail matter were placed together they would make a band seven feet wide around the world. The total weight carried is 664,286,868 pounds. To transport this enormous weight would require 33,214 freight cars, forming a train 300 miles long, hauled by 500 locomotives, aggregating 500,000 horse power, and the locomotives alone would require seven miles of track. It should be remembered that mail matter carried on trains is not packed tightly, as in the vast train we are considering, where it is estimated that 10 tons of matter are closely packed in mail bags. As a matter of fact, only on very few trains is the mail carried in this way. Sometimes a trailer or supply car is used, which is packed solid with mail bags, and they are brought forward to the sorters as becomes necessary. It is impossible to make any reliable comparison of mail as actually carried, and it is possible to assume that only freight cars are filled with mail, for the sake of argument. One of our diagrams gives a graphic representation of the way second-class matter is mailed. It shows that five cities receive practically all the second-class matter mailed, New York receiving 80,586,745 pounds; Chicago, 43,461,123 pounds; St. Louis, 19,295,297 pounds; Boston, 17,478,873 pounds; Philadelphia, 17,172,533 pounds; all other places receiving 262,239,710 pounds.

We now come to the financial side. The postal revenue is represented in our engraving by a pile of ten-dollar gold pieces 47,000 feet high. Total revenue for the fiscal year 1899 was $95,021,384. The total expenditures amounted to $101,632,160, leaving a deficit of $6,610,776. Had 176,351,613 pounds of mail matter, which was really third-class, been transmitted at the pound rate, and paid for as it should have been, the financial statement would have exhibited a surplus of $17,637,570. Or, if this matter would pay only a nominal rate of eight cents a pound, there would have been a surplus of $5,733,836 in the year we are considering. The amount of postage actually received for a pound of first-class matter was 85·6 cents; second-class-matter, ·8 cents; third-class matter, 14.7 cents; foreign matter, 46 cents; postal cards, 188·2. The expense of the transportation of the mail matter is reckoned at eight cents a pound.

The number of registered pieces carried was 16,086,022. There were 29,976,371 Post Office money orders issued, the aggregate value being $224,958,363. The Dead Letter Office received 6,855,983 pieces of mail matter. Of this amount 367,469 were misdirected, 71,919 were without an address, 4,903,700 were unclaimed, and 113,917 had fictitious addresses. The number of stamps issued was 4,917,269,025.

The total number of Post Offices in the United States is not far from 75,000, and the number of employés is estimated at 200,000. It should be remembered in dealing with postal figures that they are apt to be slightly erroneous, and in nearly every case the weights are greater than those which we have given, though they are sufficient to show the wonderful magnitude of this most important branch of the government service.

Automobile News.

An automobile show will be held at Madison Square Garden, November 3 to 10. All of the floor space has been taken and the boxes on the north side of the Garden will be floored over to give additional space. There is every prospect of a successful exhibition.

The idea of utilizing a motor haulage in connection with the market gardens near the metropolis has been suggested in the general and automobile press of late, and it is satisfactory to see such a journal as The Gardeners' Magazine giving the notion its approval. It recognizes that motor vehicles would obviate some of the difficulties that market gardeners have now to encounter in getting their produce to market, and considers that it would certainly pay some enterprising carrier to make the venture.

The Schwabischer Mercier says:—"Our Swabian industry has a gratifying success to record. The military motor wagons manufactured by the Daimler Motor Company at Cannstatt, with which, as already mentioned, exhaustive tests were made with various kinds of weapons by the Ministry of War in the presence of officers of high rank, in the neighborhood of Quedlinburg and on the Brocken, were also exhibited to the Emperor." The Berlin local paper reports as follows: "We congratulate the Daimler Motor Company, which, as is well known, is bringing out the patents of G. Daimler, on this new and grand success. Four benzine motor wagons have been built experimentally for the conveyance of the baggage of the troops and for the speedy conveyance of the troops. They were brought to notice by Major Madlung, of the Ministry of War. Before exhibiting them to the Emperor they were carefully tested in the country. The trial began at Quedlinburg, and extended over the Harz territory to Gernrode, Suderode, Thale, and Blakenburg. The baggage wagons, the largest of which was loaded with 45 cwt., had not only to travel over the good, but steep mountain roads to Harzgerode, Hexentanzplatz, and Friedrichsbrunn, but had also to go over stony and sandy field roads and loose plowed lands for long distances. Two baggage and two passenger wagons, heavily loaded, undertook the daring feat of crossing the Brocken from Quedlinburg, over Hexentanzplatz, Treseburg, and Schierke, in which they successfully competed with the Brocken Railway. From the summit of the Brocken the four wagons performed the journey over Ilsenburg, and Halberstadt to Magdeburg, in six hours. On the second day, at midday, they reached Berlin. A large number of officers accompanied the trial journey from the beginning to the end. As already mentioned above, the driving power was a benzine motor. The baggage wagon has the appearance of the goods van of a train. The passenger wagon is similar to the motor cabs in use in Berlin. The Emperor ordered the wagons to drive in front of the New Palace, and made inquiries of Major Madlung as to their construction. It is said that the troop wagon intended for quick service can travel 40 kilometers per hour. Mr. V. Gossler, the Minister of War, and General V. Hahnka were present at the inspection. The Emperor was not sparing in his praise of the unusual performance." Since the above was written we understand, says The Automotor Journal, that as a result of these trials the German War Office has placed an order for five motor lorries with the Daimler Motoren Gesellschaft. Curiously enough, an offer to submit the same type of vehicle to trial by the British War Office was curtly rejected. Before, however, condemning the War Office, we must remember that the type of motor referred to implies an abundant supply of petrol. In France and Germany such a supply could always be relied upon, even in war time, but petrol is, we fancy, a scarce commodity in South Africa, and hence a petrol motor would have but a very small chance of successful operation.

Correspondence.

The Armament of Our New Battleships and Cruisers.

To the Editor of the SCIENTIFIC AMERICAN:

Those of your readers who, like myself, are interested in naval matters would, I think, be glad to find in your columns an expression of your views on the armament of our new armored cruisers and battleships.

That of the cruisers, as given in your issue of August 11, at page 90, viz., four 8-inch guns and fourteen 5-inch, would seem to be rather feeble for vessels of 13,500 tons displacement.

So many vessels of the armored cruiser class are now built with ample protection of 6-inch Krupp armor, against which the 5-inch gun is quite ineffectual and which even the 6-inch is powerless to penetrate at the ranges which would obtain in action, that the sole reliance of these cruisers for inflicting material injury on vessels of their own class must be upon their 8-inch guns, and of these they are to carry but four, while the "New York," if my memory serves me, carries six and the "Brooklyn" eight, and their displacement is about 4,000 tons less than that of the new cruisers. A recent design for armored cruisers for the Italian Navy calls for a vessel of 20 knots speed, 8,000 tons displacement, well protected with 6-inch Terni armor and carrying twelve 8-inch guns, eight of which can be brought to bear on either beam and six ahead and astern.

Such a vessel would seem to be more than a match for our new cruisers, and I am eager to know what reason exists for giving ours such inferior offensive power in spite of their greater size.

It may be, however, that in giving in your issue of August 11, the armament proposed for the cruisers of 13,500 tons, that for those of 8,000 tons, authorized by the same act, has been given.

Even should this prove to be the case, we would still seem to have designed a much less powerful vessel than the Italian design of the same displacement.

A similar criticism, viz., that of carrying too few 8-inch guns, may be made on the battleships of the "Georgia" class.

Apparently (SCIENTIFIC AMERICAN, July 28, 1900) they are, like the "Kearsarge" and "Kentucky," to carry but four 8-inch guns, while the "Rhode Island" and "Virginia," on the same displacement, carry eight, the armament in all other respects being the same, with the exception that the "Rhode Island" and "Virginia" have two less 6-inch guns than the "Georgias."

One is forced to ask what advantages the "Georgias" possess to compensate for their inferior armament, for inferior it certainly is.

I hope that you may deem these matters of sufficient interest and importance to justify an expression of opinion thereon on the part of the SCIENTIFIC AMERICAN.

EDMUND M. PARKER.

Peterboro, N. H.

Air Resistance to Moving Bodies.

To the Editor of the SCIENTIFIC AMERICAN:

The experimentalists who have preceded Mr. Adams in the field of air resistance to fast railway trains, have shown, so far as we are able to judge, from the data which they have placed at our disposal, that the cone-shaped body of air, which is swept along in front of the locomotive, is quite as efficient as any substitute that they are able to devise for the reduction of frontal air resistance to the passage of the train. If they could have first satisfied themselves that nature offers this assistance to the solution of the problem of fast transportation, it is probable that, like Mr. Adams, they would have at once abandoned this part of the experiment, and confined their investigations to the determination of the extent of the frictional resistance against the larger surfaces of the following train. Nature's "air-splitter" adds nothing to the weight of the train, and also reduces friction to the minimum.

The writer has endeavored to show, in previous articles, that the minimum of frictional resistance is also attained by the envelop of air that accompanies the entire train; that this envelop of practically conjectural air will always be present, however smooth the walls of the train, or regular and unbroken their contour; and that all attempts to attain a lower resistance will necessarily fail, because there is no available material for the construction of housings that will take the place of the light and volatile substance that Nature supplies and adjusts to the best possible advantage.

If railway trains were constructed with wide extending projections, of large frontal areas, so that the volume of air-displacement would be materially increased, there evidently would be something to be gained by their removal; but as this is not the case, it is probable that Mr. Adams' train, like every other, carries with it, in still weather, a large body of air, extending many feet on either side of the road-bed.

A light breeze is sufficient to remove the greater part of this body of air from the windward side of the train; but on the leeward side it is somewhat extended thereby. It has also been observed that the column of moving air is much deeper toward the rear of the train, so that if we suppose the entire volume disturbed to be made visible, it would present the spectacle of an enormous wedge-shaped body, accompanying the train at varying velocities, trailing its outer strata along the roadside, and pressing the swiftly moving currents nearest the train into the partially rarefied column that follows in the rear. After the train has rounded a sharp curve, the inertia of the air currents carries them a considerable distance, on the convex side, in a line tangent to the curve, and the train proceeds several hundred yards before an equal body of air is collected. It would seem, at first sight, that the accumulation and disbursement of such large volumes of air should make a serious draught on the power of the engine, but that such an assumption is unwarranted is shown by the fact that, among others of similar import, the slightest breeze, blowing at any angle across the track, is sufficient to reduce them, on the windward side, to a depth too shallow to be safely observed from the roadside.

A steam or sailing ship passes through a medium many times heavier, with relation to bulk, than itself, which is quite the reverse of a railway train, and the work of overcoming the inertia of the water, which is forced into currents of varying directions and velocities, is, therefore, only superficially analogous to that of a train and its relation to air resistance. It is easy to understand how a yacht's speed may be accelerated by a correctly drawn contour; but it is doubtful if the advantages of a burnished surface below the water line, if at all appreciable, have ever been accurately determined. If a film of water, however thin, clings to the walls, the work expended in polishing their surfaces has surely failed of the intended result. The fast ship drives the water, owing to its inertia and interchangeability, in almost all directions; the fast train, when passing through an equally still medium, owing to its slight inertia, draws with it an enormous body of air.

A speed of twenty-five or thirty miles an hour is very readily attained, by properly proportioned passenger trains, for the reason that within these limits the horse power of the engine increases with enormous rapidity, and, with late cut-offs, the limit of the boiler's capacity is soon reached. At fifty miles an hour, with average sized driving wheels, the best ranges of expansion are necessitated, and the utmost power of the engine is usually attained, owing largely, at higher speeds, to well-known difficulties of admission, compression and exhaust. Nevertheless, it is a well established fact, that on level roads, without any substantial increase in power, and at very high velocities in spite of serious reductions in effective cylinder pressures, speeds of eighty, ninety, and even one hundred miles an hour are still possible. As every ounce of train resistance, whether atmospheric or frictional, is measured with unerring accuracy, by the horse power developed, and, as the maximum power cannot be maintained at these excessive speeds, it follows that the total train resistance must then be correspondingly reduced, and especially as the work of speed acceleration must also be taken into account. There is a very promising field for scientific research in this connection, and it is safe to say that the elucidation of these remarkable facts will not be favorable to the commonly accepted theories of air resistance.

W. F. CLEVELAND.

Moncton, N. B., Canada.

A Powerful Developer.

The following developer is recommended by Mr. A. L. Henderson, of the London and Provincial Photographic Association:

NO. 1.

Hydroquinone	120 grains.
Metol	40 "
Adurol	40 "
Water	27 ounces.

NO. 2.

Sodium sulphite	2 ounces.
Sodium hydrate	60 grains.
Potassium carbonate	60 "
Water	27 ounces.

Equal parts of each to be used.

Restrainer:—Potassium cyanide, 20 grains to 1 ounce of water, and of which 1 ounce could be mixed with every 4 ounces of developer.

The developer may be made up in two parts, one without the restrainer and another with. If the image flashes up too quickly in the former, the plate should be at once transferred to the restrainer solution.

In this, instead of the shadows fogging over as usual, they will remain perfectly clear, resulting in a complete graduated negative. He considers this restrainer much better than the usual bromide.

THE indigo production in Java is rapidly falling off. Many of the planters are growing tobacco instead. The artificial product is steadily displacing it. A new process is being used, however, which permits of obtaining a higher percentage of coloring matter from the leaf and also produces a purer indigo.

Engineering Notes.

The British Admiralty are introducing a new weapon into the English Navy. It is a modification of the Hotchkiss, but instead of being quick-firing the breech mechanism is self-feeding and automatic. The gun throws a 3-pound shell at the rate of 400 rounds per minute. It will probably be officially designated as the 3-pound automatic gun.

Field Marshal Count Von Waldersee, who is to take command of the allied forces in China, has taken with him to the scene of operations a portable asbestos house, which has been placed at his disposal by the German government. The house is packed in sections, ready for immediate erection, and when set up provides seven large and comfortably appointed rooms. The material of which the structure is manufactured is called "asbestos slate." It is proof against fire and water, is as hard as slate, and yet can be nailed and planed like a piece of wood. The substance is very light and is an excellent insulating material against heat and cold.

For several years scientists and chemists have been conducting experiments and researches, with a view to discover a means of utilizing immense heaps of spent sand and glass, discarded as refuse by the plate glass manufacturers. Messrs. Pilkington Brothers, who are probably the largest glass manufacturers in Great Britain, have an accumulation of 1,500,000 tons of this residue at their works at St. Helen, in Lancashire, and over 1,200 tons are added to this huge pile every week. The question of the profitable disposal of this waste has long occupied their serious attention. Dr. Ormondy, however, has discovered a means of converting this refuse into serviceable bricks. He has subjected some of the bricks that he manufactured from this material to very severe tests. The experiments have been eminently successful, and bricks manufactured from this waste will soon be placed upon the market. The process is said to be economical and cheap. The bricks are said to be of the highest quality, and particularly adapted to special operations, besides ordinary building purposes, for which bricks have not hitherto been proved serviceable.

In the construction of the new bridge spanning the River Thames at London a curious difficulty has arisen. When the contractors submitted their tender to the London County Council, it was expected by both parties that it would be possible to build the Westminster abutment upon the blue clay. Operations have disclosed the fact, however, that no blue clay exists at that particular spot, and examinations of the abutment of the old bridge which the present structure will replace have revealed the fact that the abutment in this case did not rest upon the blue clay either, as was at first supposed, but rested upon an abutment of timber. To excavate down to the blue clay would entail such an enormous expense that it has been decided to follow the plan adopted in the construction of the old bridge to build the abutment on piles. Consequently several hundred piles have been driven into the blue clay surmounted by a thick layer of concrete with big blocks of stone embedded. This unlooked-for development has considerably retarded the progress of operations, but now the work of the erection of the piers is in full swing. Owing to the exceptional strength of the tide at this point the work is rendered somewhat difficult. When completed the bridge will be 80 feet in width and will be ornamented only in a sufficient degree to make it harmonize with modern ideas. The bridge is not merely an ornament, but is to be of use.

Engineers cannot fail to be interested in the paper read by Dr. Goldschmidt, of Essen, at the meeting of the German Gas and Water Association, Mayence, on his new welding process with thermit. This substance, a mixture of metallic oxides with aluminium, permits a fusible mass of an especially high temperature to be produced quickly and simply. This finds employment in the production of chemically pure metals free from carbon—chromium, manganese, vanadium, and ferroboron—and is of great importance in ornamental iron work. Further, it is used for welding pipes, and rails, can be welded at any place and at any time without having a workshop, simply by means of a melting pot, at a very small cost. The welding is said to be very successful, and can stand a pressure of 400 atmospheres. Liquid thermit poured on to an iron sheet melts it as hot water melts snow. In Essen, Brunswick, and Hanover the tram rails are welded by this system. The process is as follows: The melting pot is filled with some tar oil, an inflammable mixture is added, and then lighted with a match. Spoonfuls of thermit are then added, which lights of itself; the whole is quite harmless, and temperatures of 3,000° C. can be obtained in a few minutes. The contents of the melting pot are then poured on the parts to be welded. The melted mass in the melting pot is iron, called alumino-thermo iron; on the top floats melted corundum, an aluminium oxide. The operation is carried out so quickly that the melting pot remains cold, and can be taken in the hand after being emptied. A mixture of this kind, if not too expensive, ought to be of great value to the ironfounder for burning small defects in castings.

PARIS EXPOSITION—LARGE ENGINE.

The main dynamo rooms of the Electrical Palace contain a number of large engines which drive the generators used for the lighting and power of the Exposition. The German section has four large engines, three of which are of the upright type, double and triple expansion; the fourth is a cross-compound of the horizontal type. The illustration shows the engine built by the Nuremburg Machine Company. It is vertical compound and is connected directly, on one side, to a large dynamo of 1,000 kilowatts, which gives alternating current at 5,000 volts, and on the other to a smaller direct current generator of 350 kilowatts. The engine, of the two-crank type, gives normally 1,400 horse power at 94 revolutions per minute, with a pressure of 147 pounds per square inch. It is provided with a water jet condenser. The diameters of the steam cylinders are 34½ and 53¼ inches, with a 27-inch stroke. The engine is bolted to a bed-plate, which consists of two parts; each part is cast in one piece with two bearings. The shaft has a coupling at each end for connecting with the dynamos. The weight of the engine, without fly-wheel, is about 1,320 tons. The fly-wheel shown on the right, between the engine and dynamo, is provided with teeth around the periphery, engaging with electrically-driven turning gear; the latter is driven by a direct current motor which gives 10 horse power at 600 revolutions; the motor can give a complete revolution of the shaft in about five minutes. The large dynamo on the left is of the three-phase type, built by Lahmeyer & Company, of Frankfort; it has the field magnets fixed around the periphery, and the armature, on a large exterior frame, completely encloses the field magnets. The diameter of the rotating part is 18 feet 3½ inches, and the diameter of its center of gravity 15 feet 6¼ inches. The fly-wheel consists of four pieces held together by bolts and wrought iron rings; to this the magnet-cores, of wrought iron, are bolted; they are provided with wrought iron pole-pieces. The magnets are wound with copper ribbon, insulated with paper, and are excited by the small dynamo mounted on the outer end of the shaft. The exterior crown or armature is built up of laminated iron, held in a cast iron frame, and the two end-plates, with their arms, consolidate the whole. The dynamo on the other side is a multipolar direct current generator, with 12 poles.

Method of Reckoning Time in Spain.

The Queen Regent has signed a decree establishing the method of accounting time in the kingdom, the decree to take effect January 1, 1901, viz.:

(1) In all railway, mail (including telegraph), telephone, and steamship service in the Peninsula and the Ballearic Islands, and in all the ministerial offices, the courts, and all public works, time shall be regulated by the time of the Greenwich Observatory, commonly known as Western European time.

(2) The computation of the hours in the above-mentioned services will be made from the hour of midnight to the following midnight in hours from 1 to 24, omitting the words tarde (afternoon) and noche (night), heretofore in customary use.

(3) The hour of midnight will be designated as 24.

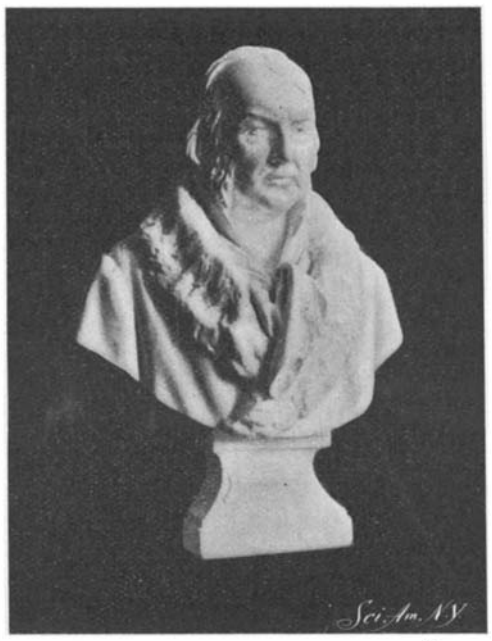
(4) The interval, for instance, between midnight (24) and 1 o'clock will be designated as 0·05, 0·10, 0·59.

THERE are 13,000,000 acres of primeval forests in Cuba.

SOME LIVING LAMPS.

BY CHARLES F. HOLDER.

Some years ago Dr. Raphael Dubois, of Paris, presented the writer with a photograph of the bust of Claude Bernard, which possesses an unusual interest, having been taken by the light of a phosphorescent insect—an elater—by M. E. Becqueral. The experiments and their details which led up to this were very interesting, but in this connection it is sufficient to say that the picture was produced after an exposure of an hour to the rays of light of this small insect. Later M. Becqueral succeeded in taking a successful picture in twenty minutes, and another in two minutes; all of which is suggestive of the possibilities of the light produced by animals.



PHOTOGRAPH OF BUST OF CLAUDE BERNARD, TAKEN BY THE LIGHT OF A PHOSPHORESCENT INSECT.

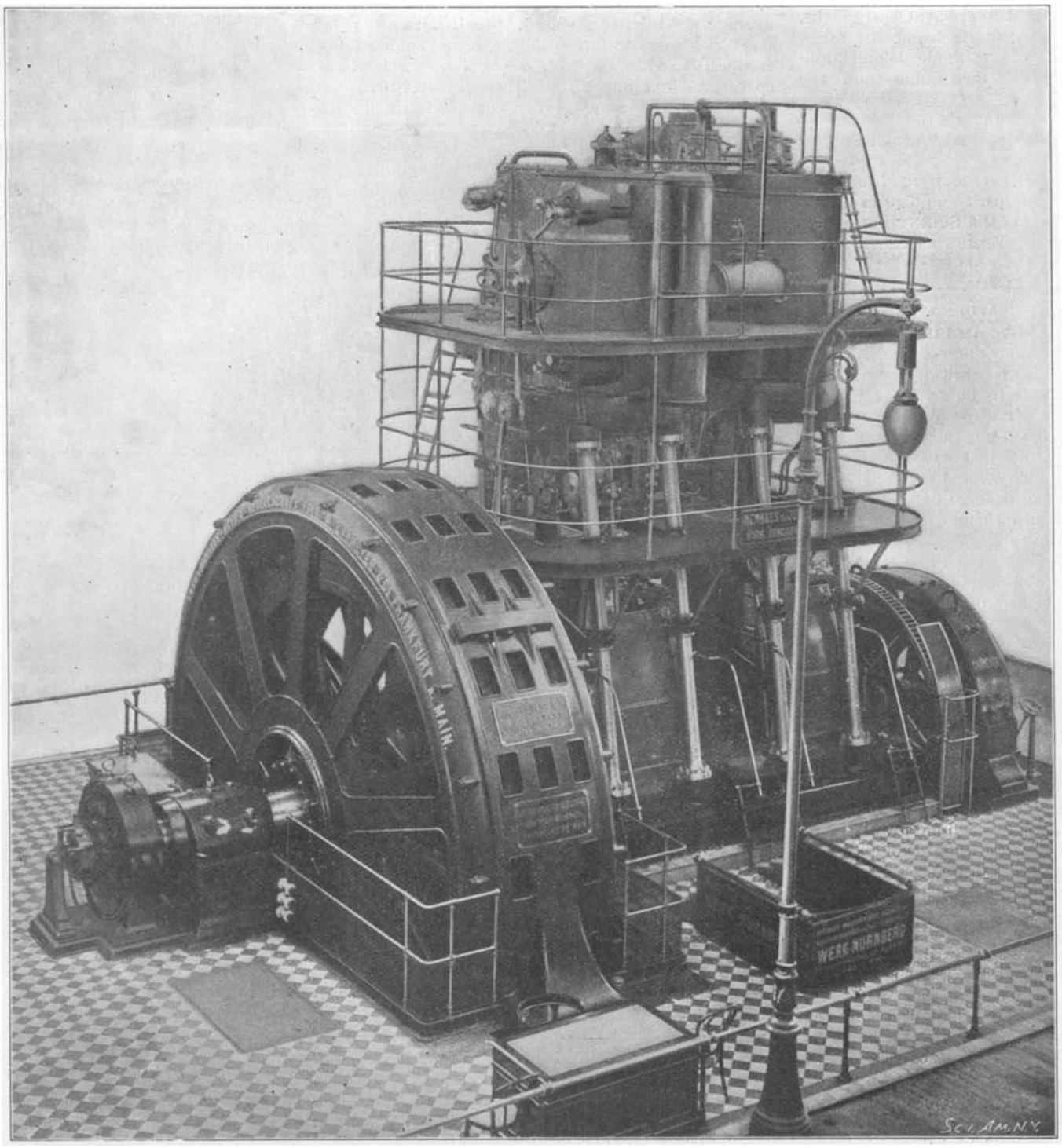
An excellent illustration of the splendor of the light of some of these insects is given by Prof. Jaeger, the German naturalist, who says, "I feel particularly indebted to these little insects because during my excursions in St. Domingo they were frequently the means of saving my life. Often has dark night surrounded me in the midst of a dense forest on the mountain, where the little animals were my only guide." The light-giver referred to is Pyrophorus noctilucus, which is provided with three different lights; on each side of the thorax is an oval yellowish spot which emits a brilliant yellowish-white light, throwing the rays upward and outward, while between the metathorax and the first abdominal segment there is a lower light more brilliant than either; and owing to their disposition, the light flashes almost continuously as the insect whirls along. The light appears to be controlled by the will of the animal, as when the insect is feeding or eating it is not seen, but becoming especially brilliant when the animal flies.

I have frequently experimented with these attractive little creatures in the South. The light when held very close to the large print of a book displayed the letters so that they could be read; the time of night was also told by holding the insect close to the face of a watch. The color of the light was green. Dubois states that the eggs of a specimen kept by him gave out a bluish light. This naturalist found that the eggs retained their luminosity for a week, the light reviving when the eggs were placed in water. He produced luminous water by grinding the luminous organs to a powder and dissolving it in water which at once assumed the appearance of molten metal.

The intensity of light is by no means in proportion to the size of the animal.

One of the most remarkable and brilliant light givers I have ever observed was a marine worm almost invisible to the naked eye; so small, in fact, that it would not be noticed by the casual observer. I have seen the surface of dark corners of a southern Californian bay dotted with seeming candlelights, the effulgence of this minute creature. At first it was noticed on the bottom, forming a luminous spot as large as a fifty-cent piece; this rapidly increased until a light as large and as circular as a dinner plate appeared. So large and brilliant a light could seemingly be produced only by a large animal, but suddenly the light began to diminish, then rise from the bottom, coming up in a zigzag course, trailing blue, green, yellow, and white flashes behind it until it reached the surface, where it rested, forming a phosphorescent light the size of a pea, but so bright that it could be distinguished thirty or more feet away. On certain warm nights I have seen the surface dotted with them. When disturbed the spot swam off with a wriggling motion, emitting as it went the various hued lights which seemed to be thrown off as a luminous fluid. Yet this brilliant light giver was a minute, almost invisible, worm.

The combined light of noctilucæ is often so brilliant that by constant irritation a light is produced by which large print can be read. A French naturalist on the African coast improvised a lamp of these living lights by taking a tube fifteen millimeters in diameter and placing in it noctilucæ, so that they formed a band at the surface twenty millimeters in thickness, when it was found that the light was sufficient to read large type by at a distance of two feet. To effect this the animals were agitated with a stick: but if a



ENGINE IN THE ELECTRICAL PALACE, PARIS EXPOSITION.

large number are placed in a glass of milk they convert the glass into a white light the intensity of which lasts several moments.

Another interesting example of a brilliant light I observed in a very small animal, in the San Gabriel Valley. In walking just after nightfall, I noticed, by the path, an intense white light, which was found to be a minute myriapod about a tenth of an inch in length; so small that I had difficulty in picking it up, though the light gleamed brightly. When it was finally secured it was seen that the light was upon the head, while another, half as bright, was seen upon the tail. The head light was extremely beautiful, reminding one of a blazing match, and was continuous.

A number of myriapods are phosphorescent. Geophilus electricus of Europe is a light giver, and often makes a magnificent display, when suddenly uncovered; M. Audoin describing the soil as sprinkled with gold where he disturbed them. One of the most remarkable displays from these insects was observed by Mr. B. E. Brodhurst, who says that the light was so brilliant that he first observed it twenty paces away. It resembled an electric light in its brilliancy, and was produced by two centipedes, and the luminous train they left behind. "The light illumined the entire body of the animal, and seemed to increase its diameter three times. It flashed along both sides of the creature in sections, there being about six from head to tail between which the light played. The light behaved precisely like the electric light, moving, as it were, perpetually in two streams, one each side, and yet lighting up the whole body. The trail extended from one and one-half feet from each centipede over the grass and gravel walk and it had the appearance of illuminating mucous."

It is possible to read by the light of the humble earthworm. One of the most brilliant displays of animal phosphorescence I have observed came from such a source. Its discovery was accidental. In passing through an orange grove one rainy night in Southern California, I kicked aside a large clump of earth, when to all intents and purposes a mass of white molten metal went flying in every direction, affording an unusual display. The cause of the light was a single, possibly two, earthworms, not over two inches in length. The luminous matter was exuding from them and had permeated the surrounding soil, rendering it phosphorescent. The light-emitting mucous came off upon my hands, and the light lasted several seconds, gradually fading away.

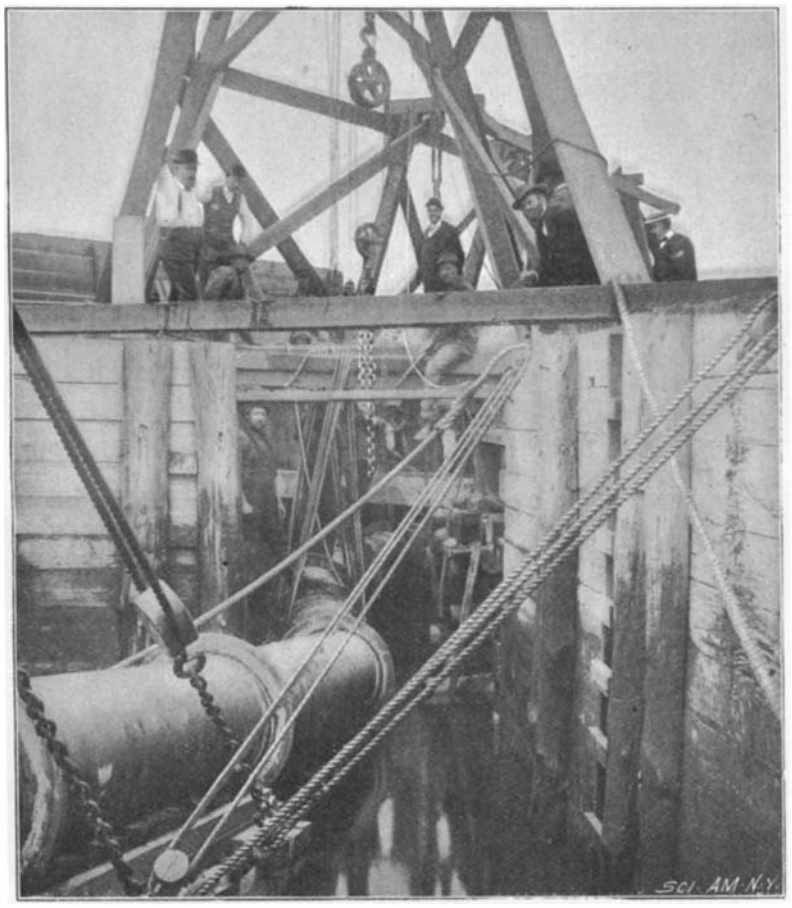
Possibly the most remarkable light ever used for purposes of reading is the beautiful Pyrosoma, a columnar, jelly-like creature, one of the free-swimming Tunicates. They are usually from one to two feet in length and three or four inches across, open at one end. The column is an aggregation of animals, each of which takes in water and expels it by an orifice in the interior; and this volume of water rushing from the open end propels the animal along. Its luminosity is wonderful, its name, fire body, well chosen. To illustrate its intensity, a Portugese sea captain secured 6 of the animals, which he placed in glass jars which were suspended from the ceiling of his cabin. By their own light he wrote a description of their beauties. Bennett, the English naturalist, placed a deep-sea shark, of the genus Isistius, in a jar in his cabin and could easily have read by its light, describing the appearance of the fish as truly ghastly.

THERE are said to be at least 5,207 motor cycles in France, on which the annual tax has been paid.

LAYING A 24-INCH GAS MAIN ACROSS THE HARLEM RIVER.

BY G. H. P. M'VEY.

The work of laying a 24-inch gas main from the Borough of Manhattan to the Borough of the Bronx, across the Harlem River, is about completed. The purpose of this pipe is to supply additional illuminating gas to the Borough of the Bronx from the mains in Manhattan Borough.



METHODS OF JOINING PIPE IN THE MANHATTAN BULKHEAD.

THE LAST LENGTH OF PIPE BEING LOWERED TO POSITION.

To complete this undertaking the Consolidated Gas Company arranged with the Seaboard Contracting Company, the latter employing a number of hands and an enormous plant to operate the work.

The plans of the work were designed by Mr. W. H. Bradley, Chief Engineer, and Mr. Colin C. Simpson, the General Superintendent of mains for the gas company. The pipe crosses the river from a point in Manhattan at One Hundred and Thirty-ninth Street to a point at One Hundred and Thirty-eighth Street in the Bronx, north of and adjoining the Madison Avenue bridge.

Preliminary work was commenced in the river last April by cutting away the bulkhead on the westerly or Manhattan shore and by removing about 100 feet of the ice fender pier of the bridge. This was done to enable the dredge and its accompanying dumping scow to operate at this point.

About 50 tons of rock and earth, as well as a mass of timber, had to be removed from the Manhattan bulkhead, which work was done mainly by the divers. This opening in the bulkhead was 60 feet long, 6 feet wide, and from 5 to 25 feet deep. Four-inch yellow pine tongued and grooved sheathing, 25 feet long, was driven, in order to hold up the sides and thus protect the divers while they were at work, and also to prevent the trench from again filling up with silt.

The divers who performed this dangerous duty, besides cutting away the bulkheads and fender pier, had to make the soundings, guide the suction pipe which removed the mud from the submarine trench, and also place the wooden blocking under the pipe where necessary.

To locate the direction of the trench, transit lines were taken from each shore. The trench has a fall of four feet in a hundred from both shores to the center of the river. It is 20 feet wide and from 10 to 20 feet deep, according to the depth of the mud and silt in the bottom of the river. The extreme length of the trench is 750 feet, from which 14,000 cubic yards of mud was dredged.

In course of time this trench will again fill up with the mud and silt deposit, thus affording ample protection to the pipe, which will lie on the hard clayey bed at a depth in the center of the river of 32 feet below mean low water.

Where the surface of the bed is depressed or uneven, heavy 6 by 12 pine timbers from 3 to 10 feet long were laid at right angles to the pipe in order to block and grade it. This latter precaution was taken in order to prevent straining, and also to avoid the formation of a trap or drip into which condensation would flow and settle, thereby choking the easy flow of the gas.

A depression of the pipe has been provided for, however, in the middle of the river, about 35 feet below mean low water mark. At this point a drip-pot has been provided, which takes the place of an ordinary length of pipe. It will hold 180 gallons. From the top of the drip-pot there will extend to the surface a standpipe, by means of which the condensation will be pumped out.

The iron pipe used in this submarine work is known as Ward's flexible joint. Each length is 12 feet long, 24 inches in diameter at the body and 29 inches at the hub or socket. The iron is one inch thick and each length weighs two tons.

Each joint required 250 pounds of lead to

METHOD OF JOINING AND LAUNCHING THE FINISHED PIPE.

calk it. It is the heaviest pipe for its diameter that was ever laid.

There were sixty-five lengths used in crossing the river. The manner of joining the lengths was somewhat novel and was as follows: The first half dozen lengths were joined on blocking in the opening of the crib work on the Manhattan shore. When the blocking was taken away the pipe hung suspended from overhead supports.

The first length was then laid close to the place where it would connect with the land pipe. The next five lengths were then lowered into the water by ropes and chains, while the seventh length and the four following were put together on the scow which had launching ways constructed on it arranged on an inclined plane.

When each section was properly jointed and calked the scow was carefully drawn ahead from under the pipe and the completed lengths allowed to gradually drop to the river bed by means of a movable launching ways suspended from the stern of the scow. As five of the regular lengths were all that could be joined on the scow at one time, the operation of launching each set of lengths was continued until the river was almost crossed. When the Bronx shore was nearly reached the section of the pipe then on the scow was dropped off while the length nearest the shore was held suspended above the river surface by means of the big derrick moored alongside. The lengths of pipe could no longer be joined in the usual manner on the scow for want of room.

The derrick boat and launching scow were then moored to a position on each side of the pipe, bridged together, and the final lengths thus supported and joined by aid of the overhead timbers, and from them easily dropped into the now shallow trench leading to the land pipe on the Bronx shore.

When the complete line of pipe was laid across the river a tension equivalent to 75 tons was brought to bear on the end of the completed pipe, in order to take up whatever looseness there might have been in the joints. This slack amounted to almost a foot after the enormous strain, which lasted over an hour, was withdrawn.

The laying of this pipe and setting the drip in the middle of the river necessitated the temporary closing of both channels of the stream, and in order to obstruct traffic as little as possible this part of the work was performed at night.

The Newport Automobile Races.

The first automobile race meet was held at Aquidneck Park, near Newport, R. I., on September 6, and was one of the most interesting sporting events ever held in New England. It was attended by 9,000 persons, and the cottagers were present in large numbers. As a result of the races, Mr. William K. Vanderbilt, Jr., holds the first championship of America, beating all vehicles with his large French racing machine. The distance for all the races was five miles.

Among those who raced their machines were Col. J. J. Astor, Mr. W. K. Vanderbilt, Jr., Mr. Royal Phelps Carroll, Mr. George I. Scott, and Mr. Peter Cooper Hewitt. In the trial heats for gasolene vehicles, Mr. Vanderbilt's racing machine was pitted against two others. Mr. Vanderbilt had little difficulty in vanquishing his two adversaries, and was three-quarters of the stretch ahead in 8 minutes 53½ seconds.

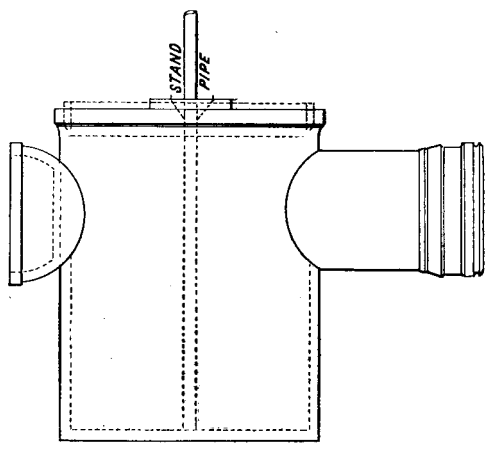
In the first race the first heat was won by Mrs. Herman Oelrichs by default, and the second heat was won by Mr. A. L. Riker, 10:44, who also won the final heat, 13. The second race was given up to tricycles; the first heat was won by Mr. A. K. Skinner, in 10:30½; the second heat was won by Mr. Charles S. Henshaw, in 9:52, and the third heat by Mr. A. K. Skinner, in 9:12. In the third race the contesting vehicles were driven by steam and the first heat was won by Mr. L. T. Davis in 10:45½; the second heat by Mr. F. H. McDuffee in 10:56, and the final heat was won by Mr. McDuffee in 10:52.

The fourth race, gasolene vehicles, was won by Mr. William K. Vanderbilt, Jr., in 8:58½; the second heat was won by Mr. W. Bishop by default, as already mentioned above, and the final heat was won by Mr. Vanderbilt, the time being 8:53½. In the final championship, all the winning vehicles were allowed to compete, and the race was won by Mr. William K. Vanderbilt, Jr., with his gasolene racing machine, his time being 8:54; Mr. A. K. Skinner, tricycle, 9:22, second; Mr. A. L. Riker, electric, 10:28½, third. Mr. F. H. McDuffee, with his steam vehicle, did not finish.

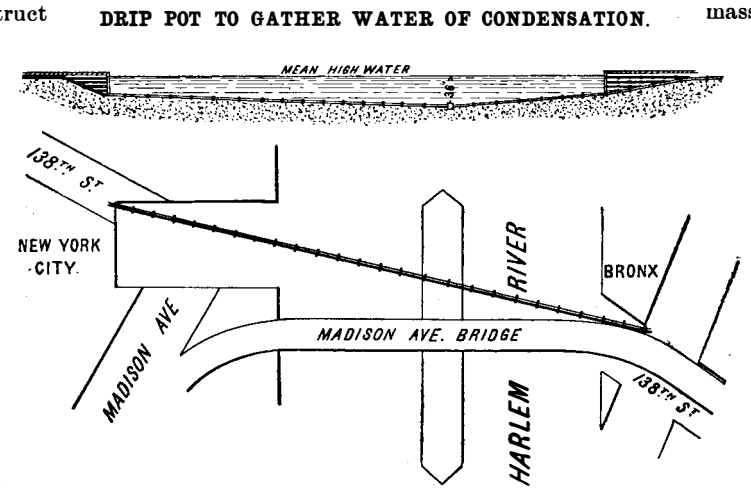
A New Mooring Device.

A public test of the Langston mooring device, invented by F. B. Langston, took place September 6, in the presence of several army and navy officers, as well as representatives of the Lighthouse Board. The inspection party went aboard the tug "Albert H. Ellis," and the inventor described his device, the object of which is primarily to keep buoys and lightships from getting out of position in a storm. It somewhat resembles the familiar mushroom anchor, and is a saucer-like disk of iron, upon the concave side of which are forged lugs, to hold the shackles and ring for attaching the chain. Between the lugs is a hole 1½ inches in diameter, and it is by the direction of a strong stream through this hole, against the bottom of which the convex surface of the saucer rests, that the device can be sunk to any desired depth. The disk which was used was only ten inches in diameter, and it was not contemplated that any conditions could arise which would demand a greater magnitude than 24 inches. The tug steamed out to Ulmer Park; a 5-inch disk was attached to a 2-inch pipe, and lowered into the water. When the disk struck the bottom, which is 11 feet down at this point, a stream of water was sent through the pipe. The disk was sunk 12 feet in the space of five minutes and thirty-eight seconds. The disk was then disengaged by means of an iron pipe, which was lowered down, and a stream of water was again turned on. A hole is made in the bottom, which releases the disk so that it can be easily brought up.

The next test was that of mooring strength, and this was made near the middle of the bay, the depth of the water being 23 feet. The 10-inch disk was again used and was lowered to a depth of 10 feet, the time required being thirteen minutes and two seconds. A buoy was then attached to the disk and the party returned for luncheon. In an hour the vessel steamed back and a ¾-inch chain was attached to the disk, and the powerful tug boat was not able to stir it, notwithstanding the fact that the engines were 450 horse power. The strain on the chain and hawser was terrific and finally, after nineteen minutes' work, the small disk was dislodged. The members of the party were particularly well pleased by the demonstration and it is believed that where the disk was properly sunk, the time allowed for the hole made by the water pressure to fill in, none of the largest ships afloat would be able to dislodge it. The danger to navigation caused by shifting buoys is very great, so that an invention which tends to do away with this danger is sure to prove of value.



DRIP POT TO GATHER WATER OF CONDENSATION.



MAP AND SECTION OF GAS MAIN.

Opening of an Andrée Buoy.

At a recent meeting of the Academy of Science at Stockholm, and in the presence of Arctic explorers Nordenskiöld, Nathorst and others, the Andrée buoy, which was recently found near Iceland, was opened. The buoy bore the inscription "Andrée's Polar Expedition, No. 3, 1896." Though it had lost its original color, it was quite undamaged, owing to the defective construction of the screw of the upper portion of the buoy; the latter could become unscrewed very easily by the waves or by pressure from the ice. The buoy could not have fallen either on land or on ice, as the under portion, which is copper, bore no indentation as the result of such a fall. This is the first Andrée buoy which has been picked up with its upper screw and copper shell in their proper condition. These have hitherto been missing.

THE Richmond Locomotive Works has received its third order for locomotives from the Finland Street Railways.

An Exhibition of Fire-Saving Apparatus at Berlin.

An exhibition of fire-preventing and fire-saving arrangements will be held in Berlin during the months of June and July, 1901, on the place where the military exercises are held at Moabit, and application for space must be made by the 1st of October, 1900. Only articles which answer the purpose of the exhibition will be accepted, and they will be taken only after examination by the managing committee. State premiums, prizes, and medals will be given. The rules of the exposition seem rather severe and arbitrary, but it will undoubtedly afford an excellent opportunity for American inventors to exploit their devices, and the medals and premiums will certainly prove of value. The general plan includes:

1. Organization of the fire brigade, dealing with clothing and equipment of fire brigades, horse equipment, dwellings for the firemen, apparatus extinguishers, escapes, apparatus for illuminating the way to and at the scene of fire. Chemical fire extinguishing means and machinery. Water supply and firearms.
2. Assistance in case of necessity and danger. Ambulance corps. Relieving persons and animals and transporting the same in cases of accident. Danger caused by water.
3. Extra professional work. Cleaning streets. Watering streets.
4. Fire-protecting means. Fireproof building constructions. Lightning conductors. Heating apparatus. Chimney sweeping. Fire-protecting apparatus for dwellings, schools, hospitals, churches, factories, storehouses, mining and electrical plants, theaters, etc., also insurance against fire.
5. Organization for the benefit of brigades.
6. Subjects of instruction, art, and literature,

New Form of Foucault Pendulum.

In a paper read before the Académie des Sciences, M. Alphonse Berget describes a series of experiments carried out by him with an improved form of Foucault pendulum. Taking as a base the invariability of the plane of the pendulum, Foucault was the first to demonstrate the rotation of the earth by his famous experiment made in 1851; in this he used as a pendulum a long metal wire having at the end a heavy spherical mass. A stylus, fixed under the sphere, strikes two small heaps of sand, placed at the extremities of the course, and the progressive marks on the sand as the pendulum oscillates show the direction and magnitude of the phenomenon. The pendulum of Foucault, it may be remarked, is many feet in length, and rises nearly to the height of the Gothic vault of the Conservatoire des Arts et Metiers, where it is now preserved. M. Berget wished to reproduce the experiment, using a pendulum of but 3 feet in length, and has constructed an instrument by which the rotation of the earth is clearly marked. A cylindrical rod of bronze carries at the end a copper cylinder weighing about 4 pounds; its height upon the rod is made adjustable by a screw-thread. At the upper part of the rod is a knife-edge suspension, very carefully made, upon which the pendulum swings. Underneath the center of the pendulum is fixed a horizontal graduated circle, carrying a slide which is movable around it by a tangent-screw; the slide carries a horizontal microscope, which may be directed to the center or near it. The slide has a vernier by which it reads to 30 seconds. Three strong oak legs support the upper table carrying the suspension; the pendulum rod passes through this, and the lower part, carrying the stylus, takes a position of repose in the central part of the divided circle, which is supported on the lower part of the tripod. All the parts are thus consolidated. The whole is placed upon a monolith pillar, separated from the floor of the laboratory.

The experiments were carried out in the physical research laboratory of the Sorbonne. The circle being made horizontal and its center brought under the stylus, the pendulum is drawn from its position of equilibrium through a very small angle, by binding it with a piece of thread to a screw placed in the plane of symmetry of the microscope. After all oscillation ceases, the microscope is directed upon the stylus, its point coinciding with the center of the cross-wires of the microscope. The thread holding the pendulum is then burned by a flame, and the oscillations commence; it is remarkable that from the second oscillation, or in four seconds after the start, the observer sees the apparent displacement of the image toward the right in the field of the instrument. As the microscope inverts the real position, the stylus is displaced from right to left, as theory indicates. The delicacy of the instrument is thus apparent; it even permits of making quantitative measurements, which correspond closely with the theoretical values. This is done by turning the tangent-screw so as to bring the image back to the center of the cross-hairs at the end of each oscillation. A number of determinations were thus made, which gave for a deviation of 1° the time 6 minutes 5 seconds, which is quite near the true value.

THE CLIMATE OF OUR NEW POSSESSIONS.

BY PROF. GUSTAVE MICHAUD, D.S.*

Our knowledge of the climate of our tropical possessions is derived from observations made by Spanish and Weather Bureau observers. The work of the latter, of course, extends over a relatively short period. The series of observations made under Spanish rule are frequently broken, but they are nearly always the work, if not of trained observers, at least of scientific persons.

In Puerto Rico and Cuba, the work of the Weather Bureau, although covering a period of only about two years, has been remarkably thorough. Indeed, it may be said that the importance of the Cuban and Puerto Rican Weather Bureau Reports rises far above that of mere local help given to agriculture, or even above that of the forecasting of West Indian hurricanes, for from the work of the sixty-one Puerto Rican and Cuban meteorological stations the scientific world is now getting its most complete and accurate information on many peculiarities of the tropical climate.

The following chart shows the fluctuations, through the year, of the mean monthly temperature in our new tropical possessions and, by way of comparison, in New York city, during those months only in which the climate of that city bears some analogy to that of tropical regions. Besides mere monthly variations of temperature, these curves show another climatic feature without the knowledge of which it is impossible to get an adequate idea of the effect of tropical heat on the human organism; during the dry season, which, in every island of our tropical empire lasts about six months, the heat, whether great or not, acts on the system about as it does in the course of our summers, that is, the air is neither much dryer nor much damper than in New England in July, but during the other half of the year the atmosphere is extremely damp; evaporation by the skin—the only process through which our organisms resist heat—is thereby restricted, and suffering is greater than it would be in most sections of the United States for a same degree of temperature. In the following chart the shading of the thermic curves is proportional to the amount of rain fallen in the corresponding month, so that one can estimate at a glance the amount of discomfort which may be expected in any particular month, not only from the mere intensity of the heat, but also from its nature, that is, from its being comparatively damp or dry, as the case may be.

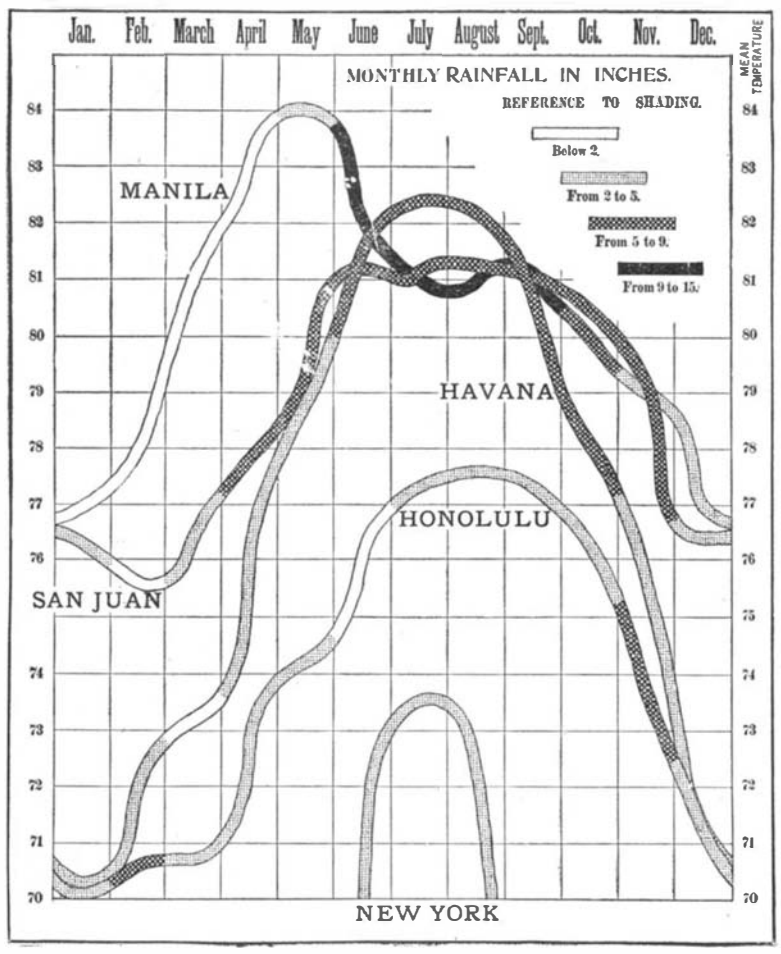


Fig. 1.—TEMPERATURE AND RAINFALL IN OUR NEW POSSESSIONS.

To complete the information contained in this chart, it is necessary to state that in none of our new insular possessions temperature ever rises much above or goes much under the monthly averages shown by the curves. The highest temperature ever recorded at Manila is 100, at Havana 101, and at San Juan 100. Continuance of heat more than its intensity is the character, *par excellence*, of tropical climate. While a tropical and a temperate country may both have, for one summer month, averages nearly identical, there is always between the two this difference, that in the tropical country the thermometer seldom goes more than ten degrees above or below the monthly average, while, outside of the tropics, in the so-called temperate zone, a thermometric monthly average is generally the result of the most extraordinary jumps above and under the number expressing it.

The climates of Manila, Honolulu, Havana, and San Juan represent probably fairly enough the relation existing between the climates of the Philippines, Hawaii, Cuba, and Puerto Rico. Other places in those islands have not always, however, the climate of the capital, for besides latitude, which, within the tropics, has not much influence on the average yearly temperature, two principal factors modify the climate of tropical regions, i. e., altitude, and in places on or near the coast, sea, and land breezes in their combination with the prevailing wind.

Altitude is the more important of these two factors. Every 300 feet brings a decrease of about one degree in the average temperature and a corresponding change in the vegetation. Tropical agriculture differs widely according to the height of the region. Cocoa is cultivated to the greatest advantage only from 300 to 1,500 feet above sea level; bananas, from sea level to 5,000 feet above; coffee, from 1,500 to 4,500 feet above sea level; tobacco, from sea level to 3,500 feet above; Indian corn, from sea level to 5,000 feet above; vanilla and the rubber tree, from sea level to 1,000 feet above. These numbers, of course, are only approximative. They are the results of random observations, not of scientific investigations. A few years ago, however, experiments conducted at the expense of the Costa Rican government by the author of this article enabled him to ascertain, with more accuracy than would have been possible in the case of other plants, that sugar cane culture for sugar making was the most profitable from 900 to 2,500 feet above sea level and ceased to be remunerative above 4,600 feet.*

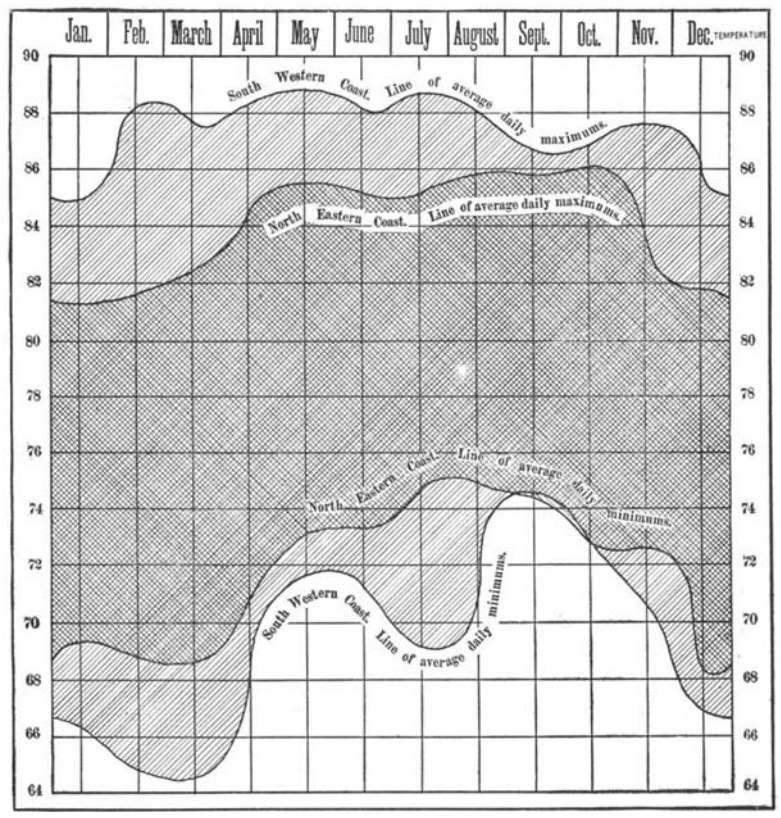


Fig. 2.—INFLUENCE OF SEA BREEZE, LAND BREEZE, AND TRADE WIND ON THE DAILY RANGE OF TEMPERATURE IN PUERTO RICO.

Health resorts in Cuba, Puerto Rico, and the Philippines are places situated at heights varying from 1,500 feet up. Such places, however, deserve their name only during the dry season. During the other half of the year, the dampness of a rarefied air lowers in some undefinable manner the vitality of the human organism and seems to be more debilitating than sojourning in the hot, and also damp, but compressed air, some thousands of feet below.

Sea and land breezes, in their combination with the prevailing wind, remarkably improve, although in widely different ways, the climate of many large cities in our new possessions. They are of considerable intensity only in places situated between the sea and some highland and not more than half a score of miles from either. A glance at the map will show that most of the littoral cities in Cuba, Puerto Rico, Hawaii and the Philippines come within these conditions.

Sea breeze results from the action of the rays of the tropical sun on the land. Heated by its contact with the burning soil, the air rises; air blows from the surface of the cool sea to fill the partial vacuum thus produced. Land breeze is the result of the contrary action. During the night, the quick cooling of the soil through radiation causes in the neighboring air a fall of temperature and thereby an increase of pressure and of density, two circumstances which act together to push it down toward the sea. Sea breeze begins to blow at about 10 A. M., and dies away in the evening. Land breeze arises at about 8 P. M. and blows in the opposite direction until dawn. Land breeze is cold from its mode of formation and also because it generally comes from high land. Sea breeze is cool too because the sea never gets heated as land does. Both bring comfort not only through their coolness but also because they quickly renew the layers of air in contact with the body and thereby increase vaporization by the skin.

Sea and land breezes modify the climate of our tropical possessions in two different ways according to the relation which those local winds bear to the prevailing wind (trade wind in Cuba and Puerto Rico, monsoons in the Philippines).

In places where the prevailing wind coincides more or less in its direction with that of the sea breeze, it increases its velocity and decreases that of the night land breeze. As a result of that action, the days cannot be hot and the nights cannot be cool. The climate is remarkable for its small daily range of temperature, that is, for its uniformity.

If, on the contrary, the prevailing wind blows in the direction of the night land breeze, it increases its force and decreases or even annihilates the day sea breeze, thus making the days sultry and creating, during the night, more cold than one would expect to feel under the tropics. The abundant data just furnished by the network of Puerto Rican meteorological stations enable us to give the following illustration of these facts:

In Puerto Rico, the prevailing wind is the northeastern trade. On the northeastern littoral, it blows in the direction of the sea breeze. On the southwestern coast, it adds its effect to that of the night land breeze. Hence two widely different climates exist on the two coasts.

On the northeastern littoral, we find four meteorological stations: San Juan, Canovanas, Luquillo and Fajardo. We have taken, for each month of the year, the average daily maximum and minimum of temperature of these four stations. With those two classes of monthly data, we constructed two curves. The distance extending between them, for any month, is of course proportional to the average daily range of temperature, for that month, on the northeastern coast. The same work was done for the four stations of Mayaguez, Lajas, Yauco and Ponce which covers the southwestern coast, and both diagrams were superposed in order to allow the eye to make instantaneous comparisons.

The data thus charted show that the daily range of temperature is invariably the greater on the southwestern littoral, and that, in February and July, it becomes about twice that of the northeastern coast. Such facts prove the importance of the combination of the local and prevailing wind as a climatic factor in our tropical possessions.

The superiority of the climate of the Hawaiian archipelago over that of our other tropical archipelagoes is due to the truly insular position of these islands. Remoteness of land is also the cause which makes the summer of Puerto Rico less hot than that of Cuba. Again, the neighborhood of the American continent, together with difference in latitude, causes the Cuban winter to be somewhat cooler than that of Puerto Rico. Of all our new territorial acquisitions, the Philippines have the hottest and, in summer, the dampest climate. The curve of Manila in our first chart fully illustrates a popular saying of the Spaniards in the Philippines:

Cuatro meses de polvo.
Cuatro meses de lodo.
Cuatro meses de todo.

Which, being interpreted, means: Four months of **dust, four months of mud, four months of everything.**

*The sources from which I took the data charted in the drawings are the following:

For Honolulu: Manuscript; data compiled for me by the United States Weather Bureau.

For Puerto Rico: 1st. Puerto Rico Section of the Climate and Crop. Publication began in May, 1899. Data was compiled from all numbers, down to June, 1900. 2d. Observations made under the auspices of the Jefatura de obras publicas de Puerto Rico. Published in Report of the Chief of Weather Bureau for 1897-98.

For Havana: Observations made at Belen College. Republished in Report of Chief of Weather Bureau for 1897-98.

For Manila: Observations made at the Observatorio Meteorologico de Manila. Republished in Report of the Chief of Weather Bureau for 1897-98

*SCIENTIFIC AMERICAN SUPPLEMENT, No. 915.

Tesla's Patents Upheld.

Judge William K. Townsend recently gave, at New Haven, Conn., an opinion which upheld the Tesla electrical patents, which had been infringed upon by several parties. The decision was remarkable in view of the fact that it went outside the usual verbiage of the Court which is used in confirming the validity of patents. Judge Townsend said: "A careful study of the evidence shows that Tesla has made a brilliant discovery. It remained to the genius of Tesla to capture the unruly, unrestrained and hitherto opposing elements in the fields of nature and art, and to harness them to draw the machines of man. It was he who first showed how to transform the toy of Arago into an engine of power; the laboratory experiment of Bailey into a practically successful motor; the indicator into a driver. He first conceived the idea that the very impediments of reversal in direction, the contradictions of alternatives, might be transformed into power, producing rotations, a whirling field of force. What others looked upon as only invincible barriers, impassable currents and contradictory forces, he seized and by harmonizing their directions utilized in practical motors in distant cities the power of Niagara."

A New Double Salt of Chromium and Ammonium.

M. Charles Laurent, of Paris, has succeeded in forming a new double salt of chromium and ammonium. He describes his experiments in a paper recently presented to the Académie des Sciences. It is well known that the sulphates of the magnesium series give, with the alkaline sulphates, double salts whose type is the salt of magnesium and potassium, $MgSO_4 + K_2SO_4 + 6H_2O$. The only chromous salt of analogous form known at present is the double sulphate of the protoxide of chromium and of potassium, $CrSO_4 + K_2SO_4 + 6H_2O$; this salt has been prepared by Peligot. The experimenter states that he has been able to prepare another salt of the protoxide, the double sulphate of chromium and ammonium. Experiments with the chromous salts are very difficult to carry out, as in the presence of air these are soon transformed to chromic salts; all the operations must be performed in the presence of an inert gas. In this case carbonic acid gas was used. Bichromate of potassium was taken as the starting point, and from this the chromous chloride was prepared by the usual reaction; this was transformed to acetate, which is but slightly soluble, by adding acetate of sodium in excess. The chromous acetate, freed by washing from the other salts, is decomposed by the proper quantity of dilute sulphuric acid. After having expelled the acetic acid by ebullition, the proper proportion of sulphate of ammonium is added. The liquid, by concentrating and cooling, deposits blue crystals, which are separated from the mother liquor, always out of contact with air, and dried upon kaolin. This is the double salt of chromium and ammonium; it appears in fine crystals of a blue color, resembling copper sulphate. Analysis gives the formula $CrSO_4 + (NH_4)_2SO_4 + 6H_2O$. Water dissolves this salt in considerable proportions; it possesses the reducing properties of the simple chromous salts, and in the presence of air it is transformed rapidly to the chromic salt. The difficulty of preserving it from contact with air does not permit the exact determination of its crystalline form, but by its formula and external appearance it has a close analogy with the double salts of the magnesium series. This compound, into which the protoxide of chromium enters, shows another point of resemblance between chromium and iron.

Ordnance at the Pan-American Exposition.

The display of ordnance and war articles at the Pan-American Exposition will be a most notable one and will vary from a 12-inch rifle to a pocket emergency ration. There will be field batteries of artillery, camp equipage, machine and rapid-fire guns, torpedoes, small arms, and the shipbuilding industries will be fully represented. In fact, everything will be shown that will tend to interest foreign purchasing officers. This exhibit will be a commercial one and will be entirely distinct from the government display. Nearly all the South American countries have declared their intention to send a special commission to this country to investigate the war goods offered. It is planned to have a tunnel built under the bluff on which the ordnance will be located. Guns will be fired through this tunnel, and the conditions will approximate as much as possible those obtaining on government proving grounds. This is undoubtedly an entirely new venture for an Exposition and cannot fail to prove of the greatest interest. The firing range at Buffalo will be over the surface of Lake Erie, and it is hoped to make a new record for long range work. The object of the display is to demonstrate to official commissions of foreign countries the great capabilities of American plants to undertake the filling of all military and naval orders of foreign States.

The Building Edition for September.

The September number of the BUILDING EDITION OF THE SCIENTIFIC AMERICAN has the usual choice selection of houses of various prices, and among the other interesting features are "The Scoville Memorial Library at Salisbury, Conn."; "A Group of Artistic Door Knockers," measured details of interior fittings, "Fireproofing Wood," and other subjects of equal interest.

The Current Supplement.

The current SUPPLEMENT, No. 1289, has many papers of unusual interest. "The Proposed Abandonment of the Port Royal Naval Station" is an elaborately illustrated article dealing with the subject which is now agitating naval circles. "American Engineering Competition," the ninth number of which is published in the present issue, deals with locomotives. "The Fleet of Allied Powers in Chinese Waters" occupies an entire page. "Mechanical Stoking" begins a series on this subject. "Artillery School at Jüterbog" describes some very curious experiments which are carried on at this school. "Exchange Value of Meteorites" is by L. P. Gratacap. "The Automobile Wagon for Heavy Duty" is by Arthur Herschmann, and is fully illustrated.

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RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

POULTRY NEST AND HOVER.—JOHN N. GREEN, Newtown, Ky. This portable poultry-coop is made entirely of metal, whereby the construction is less cumbrous and heavy than heretofore. The inventor has provided good ventilation. One of the novel features of the invention is a door of greater length than width. When placed in vertical position, the door prevents the hen from leaving the coop, but allows the egress of the chicks through a small opening. When placed in horizontal position, the door prevents all egress, but permits thorough ventilation.

CACTUS-BURNER.—LEWIS N. SNOWDEN, Tilden, Tex. The device is used to destroy the "spines" of the cactus or prickly-pear, so as to render it more useful as a food for cattle. Gasolene or other volatile fuel is used, which is thoroughly vaporized and burnt. The burner-nozzel is so arranged that a regulated draft is created to form a hollow or annular flame which is spread over the vaporizing-coil. The down-draft blows out of the nozzle-tip any impurities or scales which are liable to collect therein. A hood confines the flame to the vaporizing-coil until every part has been thoroughly heated.

SEAT ATTACHMENT FOR HARROWS. — OTTO W. SKORKOWSKY, Harrah, Oklahoma Territory. It is the object of this invention to provide an improved wheeled attachment for harrows or like implements, whereby the driver's seat is carried and adapted for adjustment, so as to counterbalance the draft appliances. The improved attachment comprises two bars hinged together at their front ends and fixed to an axle which is formed of two lapped parts adapted to slide on each other. Through the axle and the seat-supporting bar, a bolt is passed, which serves to secure the axle parts and seat-bar in any adjustment.

Electrical Apparatus.

CABLE-HANGER. — CLEMENT E. BEARD, Columbiana, Ohio. This hanger for telegraph and telephone cables comprises two members pivotally connected with each other and provided with prongs for engaging the cable. Hooks engage the hanger-support; and these hooks are arranged to overlap when the hanger is closed. The hooks can not open accidentally; nor is the cable or its envelop liable to be marred.

ELECTRIC MOTOR.—EDWARD A. HENRY, Crestline, Kans. The motor is particularly adapted for operating vibrating fans or other devices requiring little power. In this motor the armature oscillates, for which reason the inventor was chiefly concerned with devising some simple form of controller which would periodically change the direction of the current. The current is fed by an angle-lever, the two arms of which alternately engage two contact-plates connected with the armatures. The current changes in direction as the armatures reach the end of their travel.

ENGRAVING-MACHINE. — CHARLES CHEVALIER, Brooklyn, New York city. Heretofore the design to be engraved upon a watch-case, for example, has been raised or produced in metal on a pattern-disk, necessitating considerable work in routing out the metal around that surface which represents the design. According to the present invention, the design is cut into the metal or made in intaglio; and the cut surface is filled with wax or with other non-electric conducting material; or the design is drawn or painted on the pattern-disk with a material which is a non-conductor of electricity. When an electric tracing-finger engages with the filling in the design, the circuit is broken and the cutting-tool carried away from the surface.

Engineering Improvements.

STEAM-JET FLUE-CLEANER. — HOOKER I. COGGESHALL, Wortendyke, N. J. Steam of high pressure is passed through a blower-pipe into the conical head of the cleaner and highly heats the head. The pressure of the steam causes a current of air to be drawn between spiral-wings over the head and mingled with the steam-jet. As the air-current mingles with the steam, the combined jets coact to loosen and blow out the scale.

VALVE.—DAVID GILCHRIST, Concord, N. H. This valve, for use on expansion steam-engines, consists of a steam-chest connected with the ports of both the high and low pressure cylinders. A main valve, reciprocating in the steam-chest, is arranged to control the admission of the steam to the high-pressure cylinder. An intercepting-valve under control of the engineer, and operating in unison with the main valve, regulates the exhaust of both the high-pressure and the low-pressure cylinder and the admission of the live steam to the low-pressure cylinder.

VALVE.—ALBERT P. BROOMELL, York, Penn. The valve, although capable of general application, is especially designed for use in connection with a steam-heating system previously patented by Mr. Broomell. In this steam-heating system it is desirable to open a vent to the air when the steam is shut off from the radiator. The valve forming the subject of this patent is adapted to vent to the atmosphere when it is adjusted to close or shut off the port leading to the supply.

Mechanical Devices.

LOCK.—WALTER E. EMERY, West Chicago, Ill. This lock is especially adapted for use in connection with switches to hold the switch-point secured, but it may be also used in various other connections. The lock has a bolt adapted to be thrown by the key. A tumbler serves to hold the bolt in closed position and is also adapted to be thrown by the key to release the bolt. A chock-bar serves to hold the bolt in open position during certain periods of the operation of the lock. A keeper-plate fastened adjacent to the chock-bar limits its movement.

ATTACHMENT FOR EMBROIDERING MACHINES. — JOSEPH GRUBMAN, Brooklyn, New York city. The machine is of the Bonnaz or other type; and the attachment thereto stitches braid, chenille, tape, cord, bands, or the like upon the fabric to be embroidered in such a manner as to produce ruching or fluting effects. Mechanically considered, the attachment consists of a sleeve mounted to turn on a reciprocating needle-bar, on which sleeve a carrier is pivoted. A reciprocating nipple and a cam are mounted to turn on the sleeve and actuated by the reciprocating nipple to impart an intermittent rotary motion to the cam and cause a swinging of the carrier.

STAGE-MACHINERY.—CLAUDE L. HAGEN, Manhattan, New York city. The apparatus is to be used in connection with the reproduction of horse and chariot races on the stage. It embodies means for mounting and driving one or more traveling aprons at the rear of the stage, so as to represent the background of the scene, which gives the spectators the impression that the horses are moving forward. The apparatus was very successfully used in the play "Ben Hur," produced in New York city, and was fully described in the SCIENTIFIC AMERICAN for August 25, 1900.

APPARATUS FOR REMOVING MATERIAL FROM BELOW THE SURFACE. — HERBERT F. MUNN, 56 Beaver Street, Manhattan, New York city. Upon the deck of a vessel a compressor is mounted, which forces air downwardly through a pipe leading to the gold-bearing sands in a river-bed. The nozzle of this air-pipe is hinged so that it can be controlled from the deck of the vessel. The compressed air forces the sand through a second pipe adjacent to the first and discharging in a tank on the vessel. The arrangement has decided merits. In the first place, the gold-bearing sand is directly reached without removing the worthless superimposed strata; and, in the second place, the hinged-nozzle can be readily controlled properly to discharge the loosened material into the second pipe.

DEVICE FOR FILLING AND SHAPING CUSHIONS.—FANNIE L. MYERS, 47 Great Jones Street, Manhattan, New York city. Toilet or pin-cushions are held in a mold or shaping-block and the filling quickly packed therein to such an extent that it cannot shift and that a firm exterior surface is obtained of the desired shape.

DRIVING APPARATUS.—WALTER J. LE BARRON, Barre, Vt. The apparatus is designed to utilize the power of the wind for driving various devices, but is best adapted to marine propulsion. The novel features of the invention are to be found in a friction-gearing interposed between the wheel and the part to be driven. The windwheel turns a rotatable plate which is engaged by a friction-wheel. By sliding the friction-wheel toward and from the center, the speed of transmission is varied.

GAGED FEEDING-JOGGER. — ROSS H. PRATT, Portland, Ore. The feed-board or platen is provided with a gage for engaging one side of a sheet; and on the feed-board a pivoted angular jogger-arm is mounted opposite the gage and provided at one end with a jogger for engaging the opposite side of the sheet to move that sheet against the gage. The jogger is automatically moved outward, and is moved inward by a spring. The sheets are held in proper position between the jogger and the gage, while moving off the feed-board; and in case of a platen-press the sheets are brought in proper position, so that each receives the color impression at the proper place.

Railway Contrivances.

DETECTOR-BAR. — WILLIAM H. HIGGINS, Jersey City, N. J. Detector-bars are employed to detect the presence of engines or cars upon a railway-track and to prevent the movement of a switch under the engine and cars. The present invention provides such a bar of any desired length. The lower portion of the bar is furnished with any desired number of motion-plates, the lower surface of which has movement in guides or clips to impart the desired motion to the detector-bar; while the upper surface of the motion-plates serves as guides for the bar, acting in conjunction with guide-surfaces carried by the clips in which the detector-bars have movement.

PNEUMATIC SAFETY-GATE.—WILBUR F. HORN, Carlisle, Penn. The inventor has devised improvements in railroad safety-gates, whereby the gates are operated by the direct power of currents of air, gases, or vapors issuing from or entering the gates on opposite sides of their axes. These currents are produced by pressure appliances automatically actuated at a distance by the railway rolling-stock.

Miscellaneous Inventions.

ADJUSTABLE SCREW-JACK.—JOHN C. F. LONG and JAMES N. BISH, St. Mary's, Ohio. This adjustable screw-jack is especially intended for service in oil-wells in raising and lowering sucker-rods, polish-rods, valves, etc. It contains a hollow screw-rod, with a head having an offset thereon for keeping the screw-rod from turning. Also a set-screw in the head, a nut screwing on the screw-rod, a swivel mounted to turn on the nut and furnished with a head having a bore adjusted on a line with the bore in the head of the nut, and that in the screw-rod. A set-screw is in the swivel-head, with means for holding the swivel against any displacement in the head of the nut.

TOOTHPICK.—GEORGE W. SCHELLENBACH, Joplin, Mo. The toothpick has a hollow tubular body such as a quill. One end is closed and the other is formed with a point. Adjacent to this point and within the hollow body, there is a quantity of flavoring or medicinal substance, held in place by cotton wadding or other packing. When using the pick these ingredients which may be gum-camphor, licorice-root, cinnamon-bark, sirup, honey, or the like, are brought into use. The purpose of the device is to provide a substitute for cigarettes, chewing-tobacco, etc., for the use of which there is a strong inclination after eating.

TOY DRUM.—MORTON E. CONVERSE, Winchendon, Mass. The body of the drum has metallic heads with circular flanges extending toward each other and surrounding the ends of the body. Annular flanges project outwardly from the inner ends of the cylindrical flanges. Hoops surround these cylindrical flanges and rest on the annular ones. The construction of the toy enables the parts to be separated with facility and nested so as to take very little space in transportation, and to be readily put together and secured in their proper positions for use.

NUT-LOCK.—HORATIO E. DOWNING and HARRY L. DORSETT, Seward, Oklahoma Territory. To hold a nut securely so as to prevent any turning after it is screwed up to the desired place, the inventors have provided the nut with a recess extending along the bore of the nut, the bottom of the recess inclining inwardly and downwardly. A tapered locking-slide having an inner sharp corner and fitted to be driven home in the recess, forces the corner inward into the threads of the bolt. A cover removably held on the nut holds the locking-slide in place.

GARMENT-TRIMMING. — RICHARD G. MARSH, Manhattan, New York city. The fabric folds upon itself and forms a plait, the folded parts being stitched together by a wave-like line of stitching. The portion between the stitching and the folded edge on being removed forms a scalloped edge for the plait outlined by the stitching. This serves to hold the plait in position over the body portion of the fabric. There can be any

desired number of plaits in a piece of material; and any kind of ornamental stitching can be placed between the plaits.

HOLDER FOR PICTURES, STATIONERY, OR OTHER ARTICLES.—WILLIAM H. H. DICKINSON, Missoula, Mont. This holder is a combination of clamping-bars, and a screw having an orifice therein through which the clamping-bars are passed. A body-bar holds the screw in place, the screw being moved to engage the clamping-bars and hold them in contact with the body-bar. The intention of the device is to hold for use or display, pictures, books, stationery, crockery, and other articles. It is adjustable to objects of various sizes and can be readily handled and adapted to take any needed angle relatively to its support.

PICK.—WILLIAM PERRY BEVINGTON. Escondido, Cal. The inventor has devised a method for fixing a handle to a pick so as to keep the pick or point from working loose. To help secure this object, the clamping parts are made entirely of metal, thus obviating the tendency to looseness, a defect which prevails where wedges or other tightenings engage wooden surfaces. The clamping-devices consist of two members, one of which fits over the handle, the other of which receives the pick. Both members are formed with mating-slots through which a pin is passed and held in place by a wedge. The two members, when thus keyed and wedged together, firmly clamp the pick to the handle.

VALVE FOR PNEUMATIC TIRES OF BICYCLES.—FRANZ RICHTER, Cologne, Germany. The construction of the valve is simple. The essential part consists of an elastic flat tube carried in a suitable manner by the valve-box connected with the pneumatic tire. This tube has an elliptically-shaped hole narrower at the bottom than at the top and not lying in the middle of the tube, so that a narrower slit with two adjacent lips of different sizes is formed. The lower slit permits the air to enter; but when the pump is stopped, back-pressure of the air in the tire presses the smaller lip against the broader, so that no air can escape.

BROOM. — HOMER W. HODGE, Atlanta, Ga. This broom is designed for use in cotton and woolen factories and around machinery. With this end in view, the broom is made with metallic shields arranged in a manner to strengthen the broom and protect it from damaging contact with machine-frames.

FOLDING BED.—LEWIS B. JEFFCOTT, Manhattan, New York city. The bed proper has a section pivoted to the bed-casing at one end. To this section an end section is hinged, extending into the casing. The latter section has cam-faces, which are engaged by rollers in the casing when the bed is folded. The weight of the bed holds the several sections in an innermost folded position, as the pivot is located at the lower, outermost corner of the bed. Hence no springs, weights, or other devices are necessary to hold the bed in a folded position within the casing.

COCK.—JOHN MORRISON, Dubuque, Iowa. The invention provides a mechanism for permitting the adjustment of the plugs of stop and waste cocks, so that the plug may be rendered right or left handed in operation, according to the desire of the user or to the position of the cock. The essence of the invention is to be found in a novel arrangement of cap and casing, whereby the plug is always prevented from describing an angle greater than ninety degrees.

WIRE-GRIP.—HARRY A. MOSSMAN, Manderson, S. D. The device is to be used for gripping and stretching fence-wires. On opposite edges of the stock convergent cheek-plates are mounted. Against the cheek-plates jaws are movable. Guide-plates and a stop-plate are also provided. The jaws are moved forward; and the inclined cheek-plates cause the jaws to be moved toward each other. Then by means of a suitable stretching device drawing longitudinally upon the gripper, the wire may be stretched. The greater the pull on the device, the greater will be the clamping effect of the jaws upon the wire.

ENVELOP.—HENRY TRENCHARD, JR., Manhattan, New York city. In "tension-envelops" of the type in which a cord is secured to the back of the envelop by means of a tubular rivet, dust and dirt sometimes enter and thus soil the contents of the envelop. Moreover the exposed inner end of the rivet is apt to scratch the contents. To obviate these difficulties, the inventor employs a cap-piece in connection with an inner washer to cover the inner end of the rivet.

ORNAMENTAL OBJECT. — EMILE BICK and CHARLES H. HAHN, 1417 State Street, New Haven, Conn. The principal object of the invention is to ornament articles in imitation of tree-bark, with knots projecting from the surface. This effect is secured by covering the object with *papier-mâché* while in a plastic state and embedding in the *papier-mâché* plugs of wood which project and are also covered with *papier-mâché*.

APPARATUS FOR IMPREGNATING WATER WITH GAS. — EDWIN C. WORNS, Manhattan, New York city. There are one or more receivers for the water to be impregnated. The gas is taken from one or more "bottles" by pipes to the water-receivers, and the water is then charged with the gas. The aerated or impregnated waters are to be dispensed from the receivers by pipes. A chamber containing gravel is interposed between the dispensing pipes; and the water is caused to pass through this chamber, the gravel therein serving to break the water into separate globules or drops.

PIPE-COUPLING. — CARL EIBEE, Brooklyn, New York city. The mating sections in this apparatus can be quickly locked together and made water or fluid proof. They can be readily separated under all weather conditions. These sections have a transverse tongue-and-grooved connection. The part provided with a tongue has an offset bottom surface adapted for use when the sections are to be uncoupled, the other has offset faces adapted to be engaged by a clamping device and a latch between the two sections.

BADGE.—BENJAMIN HARRIS, Manhattan, New York city. This article has the ribbon-supporting rod pivoted at one end of the badge. A fastening-pin is parallel with the rod and pivoted to the badge between the pivot of the rod and the opposite end of the badge. There is a connection between the rod and the pin. The end portions of a front plate are turned back behind the back plate and engaged with the ends of the front one, to hold them together.

DEVICE FOR MOISTENING AND SEALING ENVELOPS.—CHARLES L. VOSE, Westerly, Rhode Island. The device comprises essentially a combined water-reservoir and handle, the one end being provided with a sponge and the other with a roller. After the gummed surface has been moistened by the sponge, it is evenly and squarely sealed by means of the roller. The entire method is so simple and so cleanly that the device should do away with the old objectionable method of sealing envelops.

BILLIARD-CUE-TIP FASTENER.—WILLIAM HESS, Manhattan, New York city. The invention provides a fastener for the tips of cues, which will be practically indestructible and will permit a new one to be applied whenever the old one becomes unfit for use. The fastener comprises a plate and a blade fixed rigidly in the center thereof, with its end portions extending respectively beyond the faces of the plate. The lower end part of the blade is adapted to enter the cue-stick to hold the plate in place. The upper end portion of the blade is driven into the tip to secure it.

THILL-COUPLING. — RICHARD ECCLES, Auburn, N. Y. In this invention the shaft-shackle has the eye adjustable to any size of pivot so as to permit quick shifting and prevent the accidental dropping off of the eye from the pivot. The shaft-strap has an eye at one end, which eye has a hinged section. A bolt is hinged to the strap and extends through the hinged section of the eye. A nut on the bolt is adapted to be seated on the hinged eye section. One arm of the nut engages the eye portion of the hinged section, the other, the strap.

COMBINATION PULLEY AND SASH BUCKLE.—JULIUS BROWER, Manhattan, New York city. The object of this invention is readily to permit the change of the device from a pulley-buckle to a sash-buckle, or *vice versa*. The buckles comprise separable body-members furnished with guides which receive the connecting straps when the buckle is used as a pulley-buckle. Clasp devices unite the body-members when the buckle is used with a sash. The clasp and guide being movable, one can be adjusted out of the way of the other, and *vice versa*.

APPAREL-DRAWERS. — JOSEPH R. WHITE, St. Josephs, Mo. This garment has a body and a waist-band, the latter lying closely around the waist, with its upper portion beneath the corset. The body of the drawers is formed at each side with approximating vertical slits producing a rear flap. The upper edge of this flap ends at the lower edge of the waist-band, which leaves the flaps free of the corset. The flap can be released without disturbing the waist-band. The waist-band of the garment under the corset is thus capable of being worn without interfering with the unrestricted use of the drawers.

TOY.—THALEON BLAKE, Philadelphia, Penn. The toy comprises a barrel which carries a picture. A wheel mounted therein has a non-continuous web which exposes the picture as the wheel turns. To provide for rapid revolutions, there are means for assisting the application of a blast of air to the wings carried by the wheel. The picture appears when the barrel is turned and is invisible when the barrel is at rest.

PAPER BOX.—JOSEPH T. CRAW, Jersey City, N. J. This device provides a slide-box for tacks or other small articles. It is constructed from a single piece of material, and so folds and connects certain members of the piece that a tube and a sliding-tray are obtained. The tray is capable of entire withdrawal from the tube and then spreads apart, so that the contents are made accessible to inspection. When the tray is withdrawn from the tube and spread, it can be quickly restored to its position within the tube.

APPAREL-BELT.—AMAND WIGHARD, Jersey City, N. J. The belt contains two main sections, the rear one having loops at its end through which the sections slide. There are clips on the rear ends of the sections with an elastic attached to the clips and also to the rear section. A ribbon or tape is connected with the clips and to the rear section, being between the elastic and this section. It is adapted mainly to waist-bands for women's wear. It yields lengthwise, thus securing a snug and easy fit.

WINDMILL-WHEEL. — JOHN E. ALBERS, Wisner, Neb. The wings of this apparatus can be readily set at any angle, according to the force of the wind. For a strong wind, a weight is shifted in toward the fulcrum of a lever. For a light one, the operator moves the weight outward on the lever. This insures a uniform running in light or heavy winds, and without requiring the turning of the wheel out of the course in which the wind is blowing. By this arrangement the wind-wheel is never unduly strained.

HORSE-CHECK.—ROBERT T. GEER, 178 West 94th Street, Manhattan, New York city. This simple horse-check comprises practically two parts, a bracket-strap and a check-rein, so arranged that a pull upon the check-rein will cause the bracket-strap to bring pressure upon the glands of the neck which lie just back of the jaw-bones and constitute the most sensitive part of a horse's neck. So efficient is the device that a horse can be checked almost instantly. The check is invisible and detracts in no way from the appearance of the animal or harness. The device is now being manufactured.

Designs.

SHOE.—JAMES H. SPARKS, Chicago, Ill. The fastening line is extended in a compound curve across the instep, with the two ends terminating at opposite sides of the front center of the shoe.

PICTURE-FRAME.—WILLIAM H. HOLTZ, Brooklyn, New York city. The design consists of a Viking ship, seated in the stern of which is a cupid holding a torch. In the sail is an opening to receive the picture. Ornaments are used to heighten the artistic effect of the whole.

GAS BURNER.—LEWIS S. BROWN, Columbus, Ohio. The body of the burner is annular and is provided with a removable flanged centerpiece. The construction is such that the interior of the burner can be readily cleaned.

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(7958) W. E. S. asks: 1. Which system of dwelling house heating is most desirable, reliable and healthful: steam, hot water or air? A. Each of the three systems named are desirable, reliable and healthful if properly installed on sanitary lines. All three systems are largely in use and each is selected to meet the tastes of house owners or first economy of erection. The hot water circulating system is probably the highest in first cost, cheap to operate, and a most convenient system to regulate in moderate weather. Steam is best suited to a cold climate where an active element of heat is required. The hot air furnace is so much a universal heating agent that but little can be said against its usefulness and convenience in small and medium-sized houses. With any of these systems used in modern dwellings ample ventilation is had from open fireplaces and windows. Where there are no fireplaces ventilating registers near ceiling and floor with flues to the roof are in order. 2. How should ventilation be provided if water or steam is used? Would it be sufficient to put in main hall on first floor of two-story house, for ventilation, seventy-five square feet of heating surface boxed in and connected to fresh-air flue of one-half square foot area? The house contains about 19,000 cubic feet of space and is occupied by six persons, use electric light and also a few kerosene lamps, say one for six hours in twenty-four. A. Artificial ventilation by a radiator in a flue closure is not needed, except in buildings of complex structure. 3. Where would be the best place for foul-air flue, and what size? If at bottom of room, how will current outside be kept from entering? A. Foul air flues, if properly provided above the roof, will seldom draw down when the house is heated. Summer drafts may be occasionally downward for the same cause as with cold chimneys. Heated rooms will always cause an up-draught in a ventilating flue. 4. Can you give rule for finding size of single and double belts for transmitting power and also size of shaft, where speed and power is known? A. The rules for belting are somewhat complicated by the angle of contact, tension, quality and kind of belting used. The rules for shafts and belts are fully set forth in tabulated form and conditions, in Kent's "Mechanical Engineer's Pocket Book," which we can furnish for $5 by mail. A general rule for single leather belts is to allow 144 square feet of belt passing a given point per minute to equal one horse power. A double belt is about 40 per cent greater in power than a single belt of same width, but must have greater tension. The rules for shafting also vary very much with the kind of metal as iron, cold-rolled iron, steel and the conditions of use; which are fully set forth in formulas and tables in Kent's pocket book.

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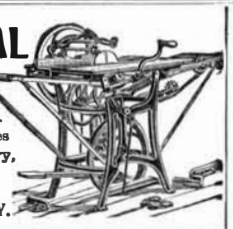

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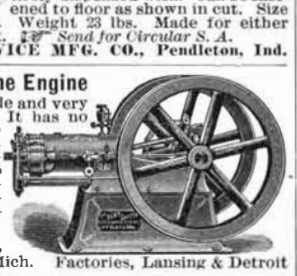

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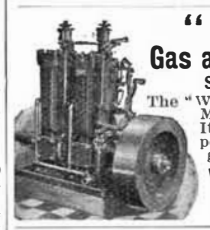

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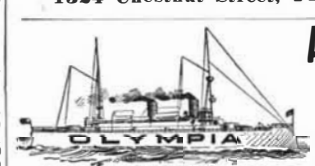

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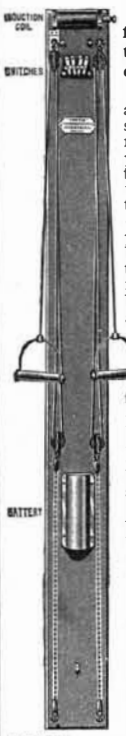

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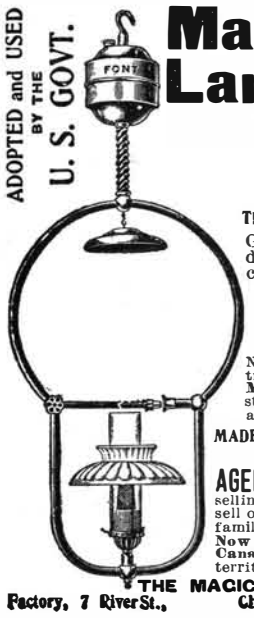

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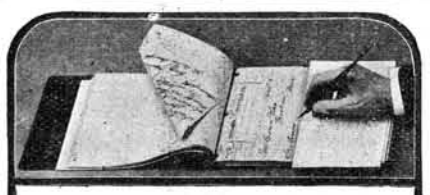

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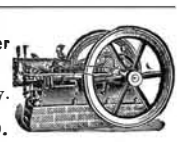

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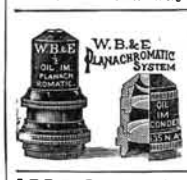

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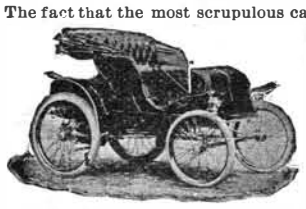

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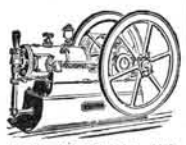

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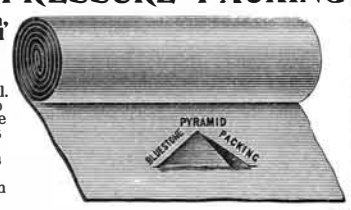

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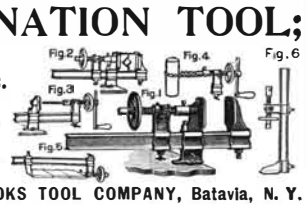

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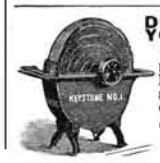

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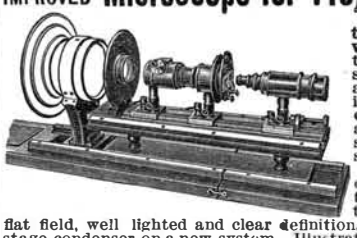

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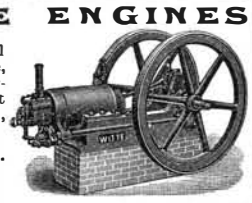

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